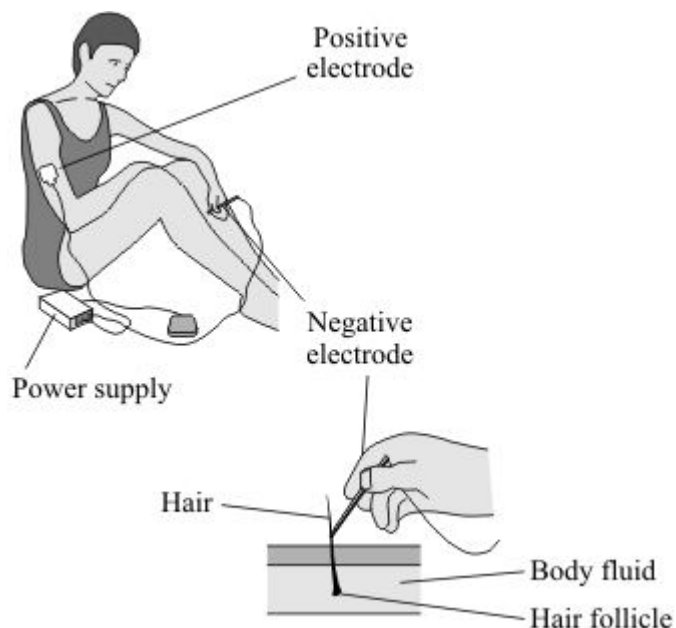


1

Electrolysis can be used to remove unwanted hair from the skin.



The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair.

The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

- (a) In this solution hydrogen ions move to the negative electrode.

Complete the sentence using **one** word from the box.

<b>negative</b>	<b>neutral</b>	<b>positive</b>
-----------------	----------------	-----------------

Hydrogen ions move to the negative electrode because they have a

..... charge.

(1)

- (b) Draw a ring around the name of the gas produced at the positive electrode during the electrolysis of sodium chloride solution.

**chlorine****hydrogen****nitrogen**

(1)

- (c) The electrolysis of the sodium chloride solution forms a strong alkali around the hair follicle.

- (i) Complete the name of this strong alkali using **one** of the words from the box.

**chloride****hydroxide****nitrate**

The name of this strong alkali is sodium .....

(1)

(ii) Suggest how this strong alkali helps to remove the hair.

.....  
 .....

(1)  
 (Total 4 marks)

2

(a) Citric acid produces hydrogen ions in aqueous solution.

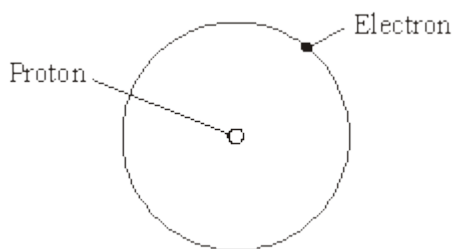
These ions can be represented as  $H^+(aq)$ .

Complete this sentence.

The (aq) means that the acid has been dissolved in .....

(1)

(b) The diagram represents a hydrogen atom, H.



Use the diagram to explain why a hydrogen ion,  $H^+$ , is a proton.

.....  
 .....

(1)

(c) Citric acid is a *weak* acid.

Draw a ring around the correct answer to complete the sentence.

	has a low boiling point.
The word <i>weak</i> means that the acid	is dilute.
	is partially ionised in water.

(1)

- (d) A student measured the pH of four acids, **A**, **B**, **C** and **D**.

The acids were the same concentration. The same quantity of magnesium ribbon was added to each of the acids. The volume of gas produced after 5 minutes was recorded.

The results are shown in the table.

Acid	pH	Volume of gas in $\text{cm}^3$
<b>A</b>	2	18
<b>B</b>	5	6
<b>C</b>	1	24
<b>D</b>	4	12

- (i) State **one** way in which the student made sure that the experiment was fair.

.....

(1)

- (ii) Use the results to arrange the acids, **A**, **B**, **C** and **D** in order of **decreasing** acid strength.

Most acidic ..... Least acidic.

(1)

- (e) When acids react with alkalis, the hydrogen ions from the acid react with the hydroxide ions from the alkali.

- (i) Which **one** of the following represents the formula of a hydroxide ion?

Draw a ring around your answer.



(1)

- (ii) Draw a ring around the correct answer to complete the sentence.

	acidic.
A solution with more hydrogen ions than hydroxide ions is	alkaline.
	neutral.

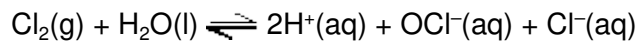
(1)

(Total 7 marks)

**3**

This question is about methods of treating water.

- (a) Chlorine is used to kill microorganisms in water. When chlorine is added to water a chemical reaction takes place. The equation for this reaction is shown below.

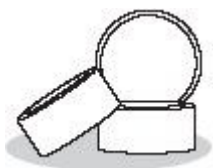


An acidic solution is produced when chlorine reacts with water.

Which ion, shown in the equation, makes the solution acidic? .....

**(1)**

- (b) Calcium hypochlorite tablets are added to water in some swimming pools to kill microorganisms.



The formula of calcium hypochlorite is  $\text{CaCl}_2\text{O}_2$

- (i) Calculate the relative formula mass ( $M_r$ ) of calcium hypochlorite.

Relative atomic masses: O = 16; Cl = 35.5; Ca = 40.

.....  
 .....

Relative formula mass ( $M_r$ ) of calcium hypochlorite = .....

**(2)**

- (ii) Calculate the percentage by mass of chlorine in calcium hypochlorite.

.....  
 .....

Percentage by mass of chlorine in calcium hypochlorite = ..... %

**(2)**

- (iii) Calculate the mass of chlorine in a 20 g tablet of calcium hypochlorite.

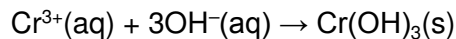
.....  
 .....

Mass of chlorine = ..... g

**(1)**

- (c) Waste water from some industrial processes sometimes contains harmful metal ions, such as chromium ions. These ions must be removed from the water before it can be returned to a river.

A method of removing chromium ions ( $\text{Cr}^{3+}$ ) from water is represented by this equation.



- (i) What type of substance would be added to the water to provide the  $\text{OH}^{-}$  ions?

.....  
.....

(1)

- (ii) A *precipitate* is formed in this reaction.

What is a *precipitate*?

.....  
.....

(1)

- (iii) What method could be used to separate the precipitate from the solution?

.....  
.....

(1)

**(Total 9 marks)**

4

Read the article and then answer the questions that follow.

### Hydrogen fuel for cars?

The diagram shows a side profile of a car. On the left side, there is a rectangular component labeled 'Hydrogen storage'. A line with an arrow points from this component towards the center of the car, where the word 'Hydrogen' is written. From there, another line with an arrow points to a component labeled 'Fuel cell'. To the right of the fuel cell is another component labeled 'Electric motor'. The entire system is contained within the outline 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.

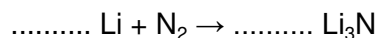
Explain why hydrogen gas is formed but not potassium.

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

(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 ( $\text{N}^{3-}$ ).

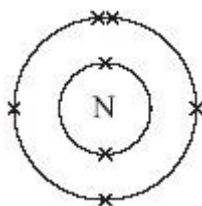
- (i) The formation of a lithium ion from a lithium atom is an oxidation reaction.

Explain why.

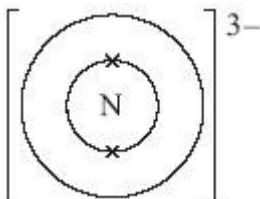
.....  
 .....

(1)

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

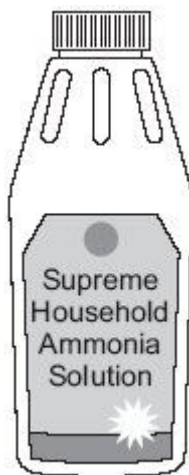


Complete the diagram below to show the electronic structure of a nitride ion ( $\text{N}^{3-}$ ).



(1)  
(Total 8 marks)

5



*Supreme* is used to clean and degrease tiles, work surfaces and windows. The active ingredient is ammonia solution, which is an alkali.

- (a) Draw a ring around the correct answer to complete these sentences.

- (i) Ammonia solution is alkaline because of

hydroxide	ions.
magnesium	
sulfate	

(1)

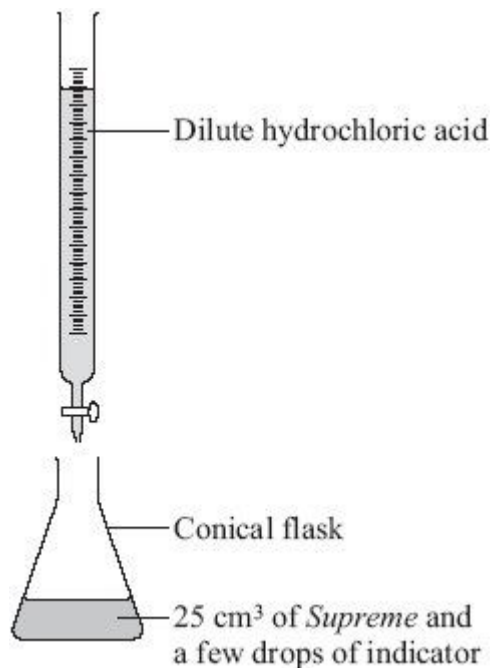


(ii) Ammonia solution turns litmus paper

blue.  
green.  
red.

(1)

(b) The diagram shows the apparatus a student could use for a titration.



Draw a ring around the correct answer to complete each sentence about how the student could do this titration.

(i) Measure 25 cm<sup>3</sup> of *Supreme* into a conical flask using a

pipette.  
test tube.  
thermometer.

(1)

(ii) Add a few drops of an indicator to the *Supreme* in the conical flask.

Then put hydrochloric acid into a

beaker.  
burette.  
measuring cylinder.

(1)

(iii) Add the acid to the *Supreme* until the indicator

changes colour.  
dissolves.  
forms a gas.

(1)

(c) The student recorded the volume of hydrochloric acid used.

Suggest how the student could check the reliability of this result.

.....  
.....

(1)  
(Total 6 marks)

6

Distress flares are used to attract attention in an emergency.



Flares often contain magnesium. Magnesium burns to form magnesium oxide.

(a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

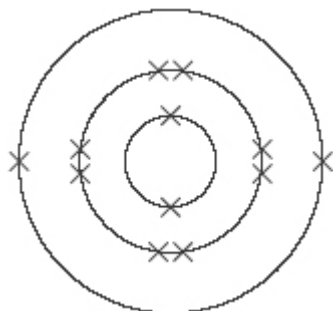
Complete the following sentence using the correct words from the box.

<b>gives out heat</b>	<b>stores heat</b>	<b>takes in heat</b>
-----------------------	--------------------	----------------------

An *exothermic* reaction is one which .....

(1)

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



**Magnesium atom**

The atomic (proton) number of oxygen is 8.

Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?

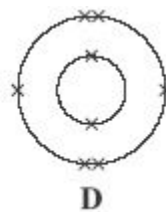
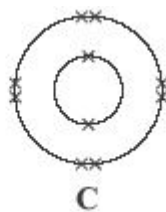
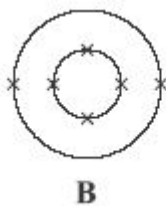
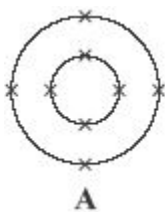
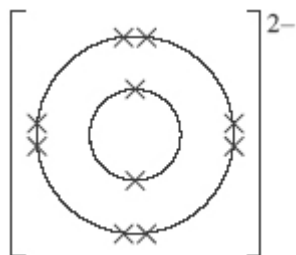


Diagram .....

(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**

Which diagram, **J**, **K**, **L** or **M**, shows the electronic structure of a magnesium ion?

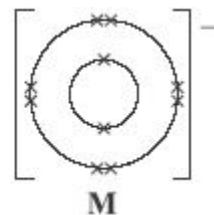
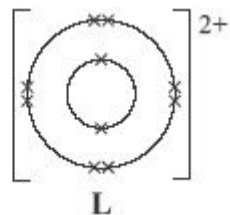
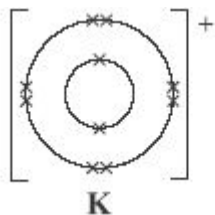
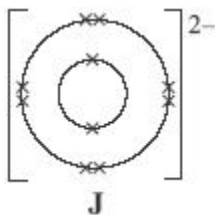


Diagram .....

(1)

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

Draw a ring around the name of the salt formed when magnesium oxide reacts with hydrochloric acid.

**magnesium chloride**

**magnesium hydroxide**

**magnesium sulfate**

(1)

(Total 4 marks)

7

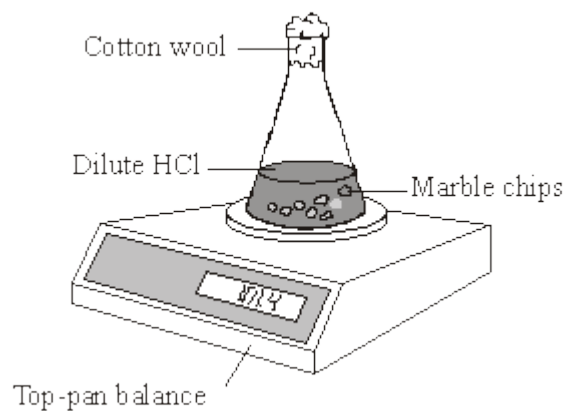
A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation.

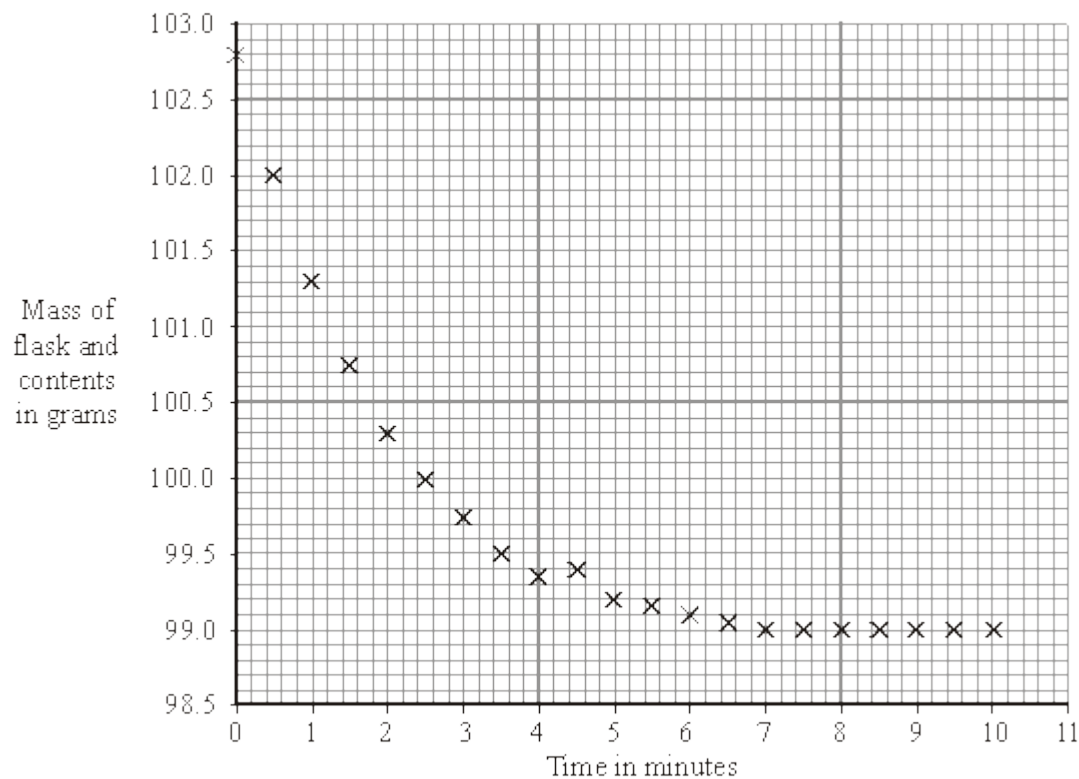


The student used the apparatus shown in the diagram.



The student measured the mass of the flask and contents every half minute for ten minutes.

The results are shown on the graph. Use the graph to answer the questions.



(a) Complete the graph opposite by drawing a line of best fit.

(1)

(b) Why did the mass of the flask and contents decrease with time?

.....  
.....

(1)

(c) After how many minutes had all the acid been used up?

..... minutes

(1)

(d) The student repeated the experiment at a higher temperature. All other variables were kept the same as in the first experiment. The rate of reaction was much faster.

(i) Draw a line **on the graph** to show what the results for this second experiment might look like.

(2)

(ii) Why does an increase in temperature increase the rate of reaction?

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

(3)

(Total 8 marks)

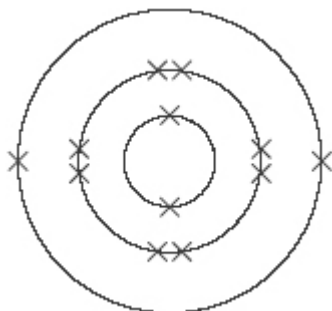
8

(a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O<sub>2</sub>) 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.



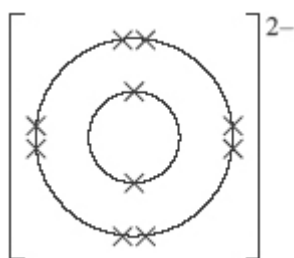
**Magnesium atom**

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.

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

(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.



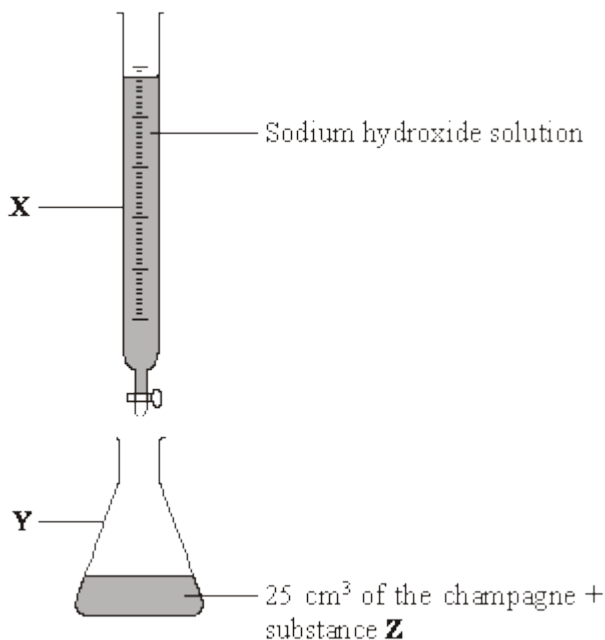
(1)

(Total 6 marks)



- 9** In 1916 a ship was sunk by a German submarine. The ship was carrying bottles of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

The diagram shows the apparatus used to find the amount of acid in 25 cm<sup>3</sup> of the champagne.



- (a) Choose the correct words from the box to name apparatus **X** and **Y**.

beaker	burette	conical flask	measuring
cylinder			

- (i) Apparatus **X** is a ..... (1)
- (ii) Apparatus **Y** is a ..... (1)
- (b) Sodium hydroxide solution was added to this champagne until substance **Z** showed that the reaction was complete. The volume of sodium hydroxide used was recorded. The result was used to calculate the amount of acid present.

Complete these sentences by drawing a ring around the correct answer.

- (i) Substance **Z** is

a catalyst
a conductor
an indicator

(1)

(ii) The reaction was complete when substance **Z**

- changed colour
- formed a gas
- gave a precipitate

(1)

(iii) The name of this method of analysis is

- distillation
- filtration
- titration

(1)

(c) 250 cm<sup>3</sup> of this champagne were found to contain 1 g of acid.

Calculate the mass of acid in 750 cm<sup>3</sup> of this champagne.

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

Mass = ..... g

(2)

(d) (i) Which **one** of the following ions makes champagne acidic?

Draw a ring around your answer.

- chloride**      **hydrogen**      **sodium**

(1)

- (ii) The acid in champagne is a *weak* acid.

Complete this sentence by drawing a ring around the correct answer.

The word *weak* means that the acid

has a low boiling point

is dilute

is partially ionised

(1)

(Total 9 marks)

10

This label was taken from a cola drink.



The pH of this drink is 2.5.

- (a) (i) Which **one** of the ingredients in the cola drink causes the low pH?

.....

(1)

- (ii) Draw a ring around the name of the ion that gives the cola drink its low pH.

**chloride**

**hydrogen**

**hydroxide**

**sodium**

(1)

- (b) The preservative used in the cola drink is sodium benzoate. Sodium benzoate is made using two chemical reactions.

**Reaction 1**

Methylbenzene is reacted with oxygen, with the help of a catalyst, to form benzoic acid.

**Reaction 2**

Benzoic acid is neutralised by sodium hydroxide solution to form sodium benzoate and water.

- (i) How does the catalyst help **reaction 1**?

.....  
 .....

(1)

- (ii) **Reaction 1** has a high atom economy.

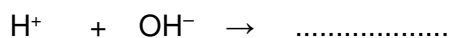
The table lists several statements. Put a tick (✓) next to the **one** statement which best describes a high atom economy.

Statement	(✓)
All the atoms used are cheap.	
Most of the starting materials end up as useful products.	
Only a small number of atoms are used in the reaction.	

(1)

- (iii) **Reaction 2** is a neutralisation reaction.

Complete the equation by writing the formula of the product.



(1)

(Total 5 marks)

11

Copper sulfate ( $\text{CuSO}_4$ ) is a salt that has many uses.

An aqueous solution of copper sulfate can be made by reacting copper oxide ( $\text{CuO}$ ) with an acid.

- (a) (i) Name this acid. ....

(1)

- (ii) Write a balanced symbol equation, including state symbols, for this reaction.

.....

(2)

- (b) Copper oxide reacts much faster with acid at 40 °C than at 20 °C.

Explain why in terms of particles.

.....

.....

.....

.....

(2)  
(Total 5 marks)

12

Nitric acid can be neutralised by alkalis to make salts.

- (i) The salt called potassium nitrate can be made from nitric acid.

Complete the word equation for this neutralisation reaction.  
Choose the correct substances from the box.

hydrogen	oxygen	potassium chloride
potassium hydroxide		water

nitric acid + ..... → potassium nitrate + .....

(2)

- (ii) Ammonium nitrate is another salt made from nitric acid.

Which **one** of the following is the main use of ammonium nitrate? Draw a ring around your answer.

**dye**                      **fertiliser**                      **plastic**                      **fuel**

(1)

- (iii) Complete this sentence by choosing the correct ion from the box.

H <sup>+</sup>	NH <sub>4</sub> <sup>+</sup>	NO <sub>3</sub> <sup>-</sup>	O <sup>2-</sup>	OH <sup>-</sup>
----------------	------------------------------	------------------------------	-----------------	-----------------

The ion that makes solutions acidic is .....

(1)  
(Total 4 marks)

13

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)

**14**

Ammonium nitrate and potassium chloride are both salts. They can be made by neutralisation reactions.

Choose substances from the box to complete the word equations for the formation of these two salts.

ammonia	hydrochloric acid	nitric acid
potassium nitrate	water	potassium hydroxide

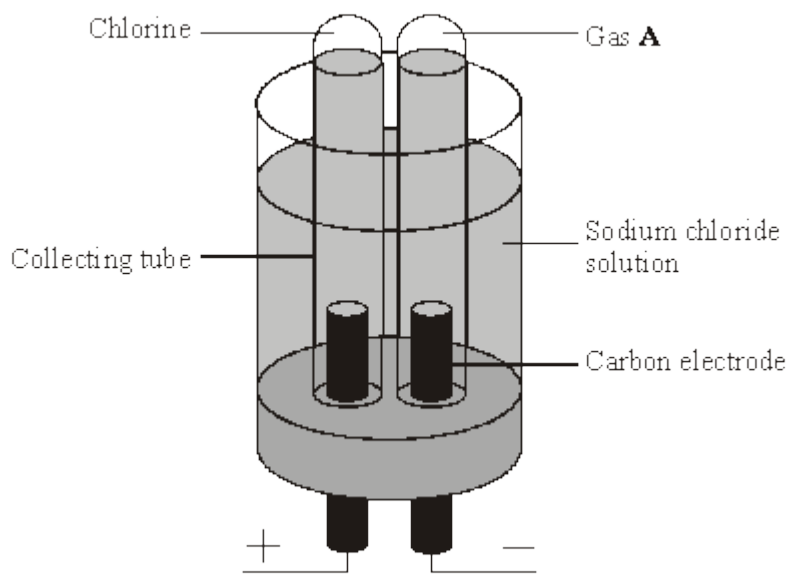
ammonia + ..... → ammonium nitrate + water

..... + hydrochloric acid → potassium chloride + .....

**(Total 3 marks)**

**15**

The electrolysis of sodium chloride solution is an important industrial process. The apparatus shown below can be used to show this electrolysis in the laboratory.



(a) Name gas A. ....

**(1)**

(b) Chlorine is produced at the positive electrode. Describe and give the result of a chemical test to prove that the gas is chlorine.

.....

.....

.....

.....

**(2)**

- (c) Chloride ions move to the positive electrode. Explain why.

.....  
 .....

(1)

- (d) A small quantity of chlorine is added to drinking water. Explain why.

.....  
 .....

(1)

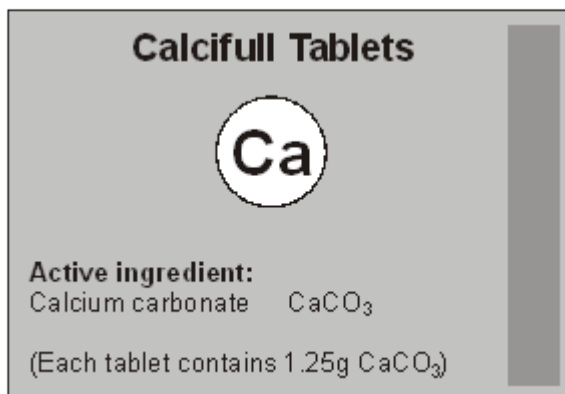
- (e) The solution around the negative electrode becomes alkaline. Name the ion which makes the solution alkaline.

.....  
 .....

(1)

**(Total 6 marks)****16**

Calcium carbonate tablets are used to treat people with calcium deficiency.



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

Relative atomic masses: C = 12; O = 16; Ca = 40.

.....  
 .....

Relative formula mass = .....

(2)



- (b) Calculate the percentage of calcium in calcium carbonate,  $\text{CaCO}_3$ .

.....  
 .....

Percentage of calcium = ..... %

**(2)**

- (c) Calculate the mass of calcium in each tablet.

.....  
 .....

Mass of calcium = ..... g

**(2)**

- (d) An unwanted side effect of this medicine is that it can cause the patient to have 'wind' (too much gas in the intestine).

The equation below represents the reaction between calcium carbonate and hydrochloric acid (the acid present in the stomach).



Suggest why the patient may suffer from 'wind'.

.....  
 .....

**(1)**

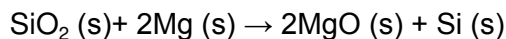
**(Total 7 marks)**

17

Silicon is an important element used in the electronics industry.

- (a) Silicon can be made by heating a mixture of sand (silicon dioxide) with magnesium powder.

The equation for this reaction is shown below.



Calculate the mass of silicon dioxide needed to make 1 g of silicon.

Relative atomic masses: O = 16; Si = 28

.....

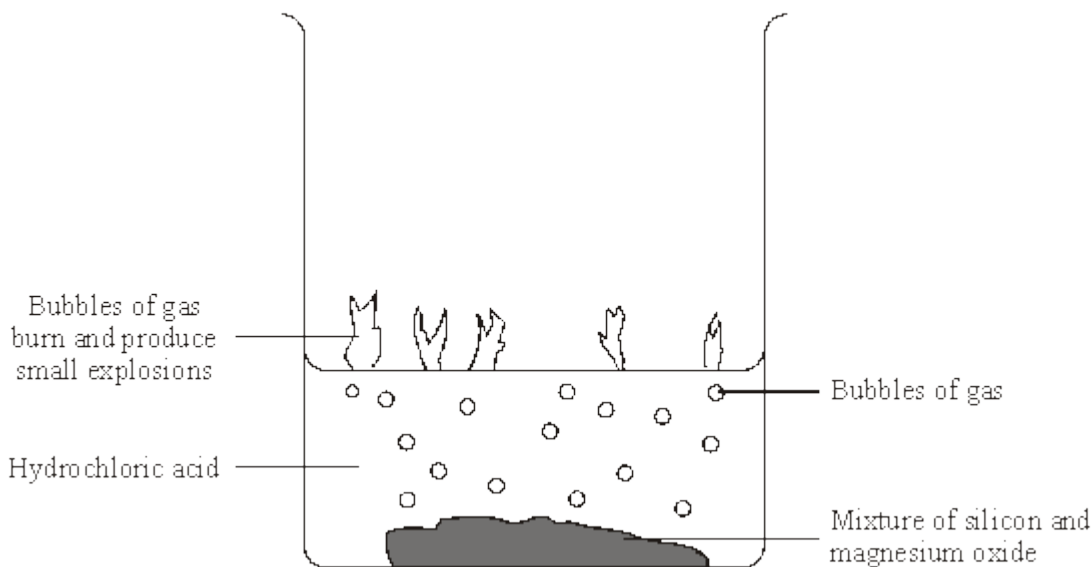
.....

.....

Mass = .....g

(3)

- (b) The resulting mixture of magnesium oxide and silicon is added to a beaker containing hydrochloric acid. The silicon is then filtered from the solution.



- (i) The magnesium oxide reacts with the hydrochloric acid and forms magnesium chloride ( $\text{MgCl}_2$ ) solution and water.

magnesium oxide + hydrochloric acid  $\rightarrow$  magnesium chloride solution + water

Write a balanced symbol equation for this reaction, including state symbols.

.....

(2)

- (ii) The gases produced are a mixture of several silicon hydrides.

One of the gases produced in the reaction is the silicon hydride with the formula  $\text{SiH}_4$ .  
The structure of this molecule is similar to methane,  $\text{CH}_4$ .

Draw a diagram to show the bonding in a molecule of  $\text{SiH}_4$ . Represent the electrons as dots and crosses and only show the outer shell (energy level) electrons.

(1)

- (iii) A sample of a different silicon hydride was found to contain 1.4 g of silicon and 0.15 g of hydrogen.

Calculate the formula of this silicon hydride. You must show all your working to gain full marks.

Relative atomic masses: H = 1; Si = 28

.....

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(4)

- (iv) The silicon hydrides react immediately they come into contact with oxygen in the air. They burst into flames with a small explosion and give out energy.

Which letter, **A** to **H**, best describes this reaction?

Energy involved in breaking and forming bonds	Activation energy	Rate of reaction	Letter
The energy released from forming new bonds is greater than the energy needed to break existing bonds	high	fast	<b>A</b>
		slow	<b>B</b>
	low	fast	<b>C</b>
		slow	<b>D</b>
The energy needed to break existing bonds is greater than the energy released from forming new bonds	high	fast	<b>E</b>
		slow	<b>F</b>
	low	fast	<b>G</b>
		slow	<b>H</b>

Letter .....

(1)

- (c) The structure of silicon is similar to the structure of diamond.

Describe the structure of silicon and explain why it has a high melting point. You may draw a diagram if this helps.

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(4)

(Total 15 marks)



Household ammonia is a dilute solution of ammonia in water. It is commonly used to remove grease from ovens and windows.

- (a) The amount of ammonia in household ammonia can be found by titration.

25.0 cm<sup>3</sup> of household ammonia is placed in a conical flask. Describe how the volume of dilute nitric acid required to neutralise this amount of household ammonia can be found accurately by titration. Name any other apparatus and materials used.

*To gain full marks you should write down your ideas in good English. Put them into a sensible order and use correct scientific words.*

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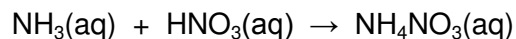
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(4)

- (b) In an experiment, it was found that 25.0 cm<sup>3</sup> of household ammonia was neutralised by 20.0 cm<sup>3</sup> of dilute nitric acid with a concentration of 0.25 moles per cubic decimetre.

The balanced symbol equation which represents this reaction is



Calculate the concentration of the ammonia in this household ammonia in moles per cubic decimetre.

.....

.....

.....

.....

Concentration = ..... moles per cubic decimetre

(2)

- (c) The salt, ammonium nitrate, is formed in this reaction.

Describe, and give the result of, a chemical test which shows that ammonium nitrate contains ammonium ions.

.....

.....

.....

.....

(2)

(Total 8 marks)

19

Salts can be prepared by the reaction of acids with alkalis.

- (a) (i) The reactions of acids with alkalis can be represented by the equation below. Choose a substance from the box to complete the equation.

carbon dioxide	hydrogen	oxygen	water
----------------	----------	--------	-------

acid + alkali → salt + .....

(1)

- (ii) Draw a ring around the word which best describes the reaction.

**displacement      neutralisation      oxidation      reduction**

(1)

(b) Sodium sulphate is an important salt.

The table gives a list of some substances.

Put a tick (✓) next to the names of the acid **and** the alkali that would react to make sodium sulphate.

Substances	(✓)
Hydrochloric acid	
Nitric acid	
Potassium sulphate	
Sodium hydroxide	
Sodium nitrate	
Sulphuric acid	

(2)  
(Total 4 marks)

20

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

.....

.....

.....

.....

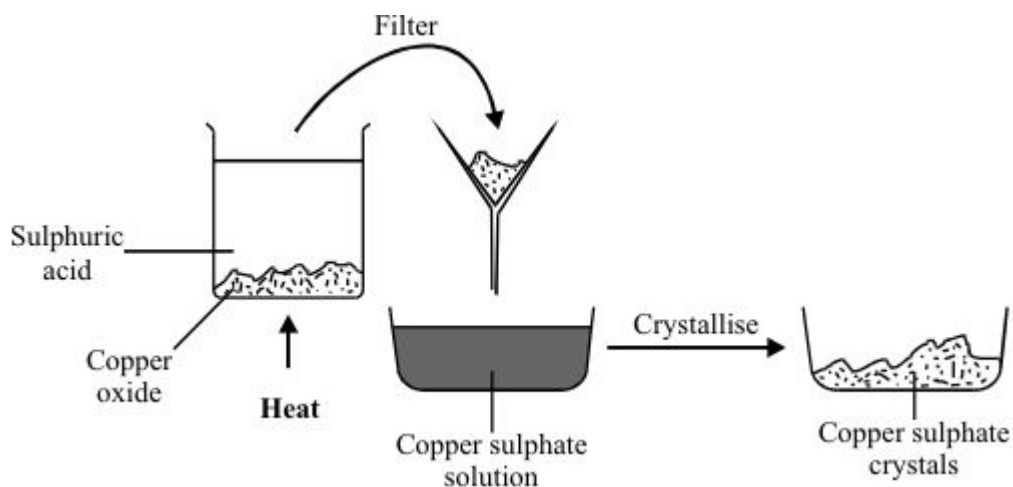
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(Total 3 marks)

21

- (a) The diagram shows one way of making crystals of copper sulphate.



- (i) Why was the solution filtered?

.....

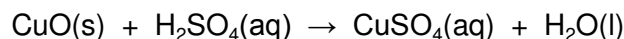
(1)

- (ii) How could you make the crystals form faster from the copper sulphate solution?

.....

(1)

- (iii) The chemical equation is shown for this reaction.



In the chemical equation what does (aq) mean?

.....

(1)

- (b) Blue copper sulphate crystals go white when warmed. How could you use the white copper sulphate as a test for water?



.....

.....

.....

(2)

(Total 5 marks)



22

(a) Indigestion tablets called antacids can be taken to react with excess hydrochloric acid in the stomach. A student investigated two different antacid tablets labelled **X** and **Y**.

(i) Both tablets, **X** and **Y**, contained calcium carbonate. Give the chemical symbol for each of the three elements in calcium carbonate.

.....  
 .....

(3)

(ii) Name the gas formed when calcium carbonate reacts with hydrochloric acid.

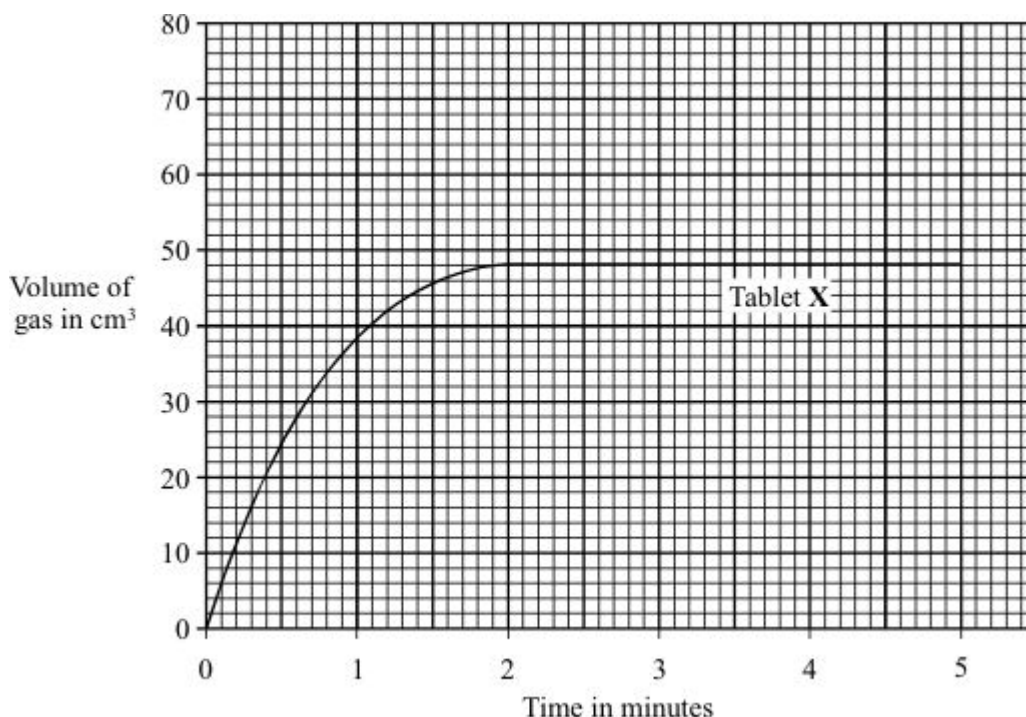
.....

(1)

(b) The student first reacted tablet **X** and then tablet **Y**, with 100 cm<sup>3</sup> of a hydrochloric acid solution. The student measured the volume of gas produced during the first five minutes. The results are shown in the table.

<b>Time in minutes</b>	0	1	2	3	4	5
<b>Volume of gas in cm<sup>3</sup> Tablet X</b>	0	38	48	48	48	48
<b>Volume of gas in cm<sup>3</sup> Tablet Y</b>	0	31	54	67	72	72

(i) Draw a graph of the results for tablet **Y**. (A graph of the results for tablet **X** has been drawn for you.)



(3)

(ii) Tablet **X** contains less calcium carbonate than tablet **Y**. How do the results show this?

.....  
.....

(1)

(iii) Explain why the rate of reaction slows down for both tablets.

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.....  
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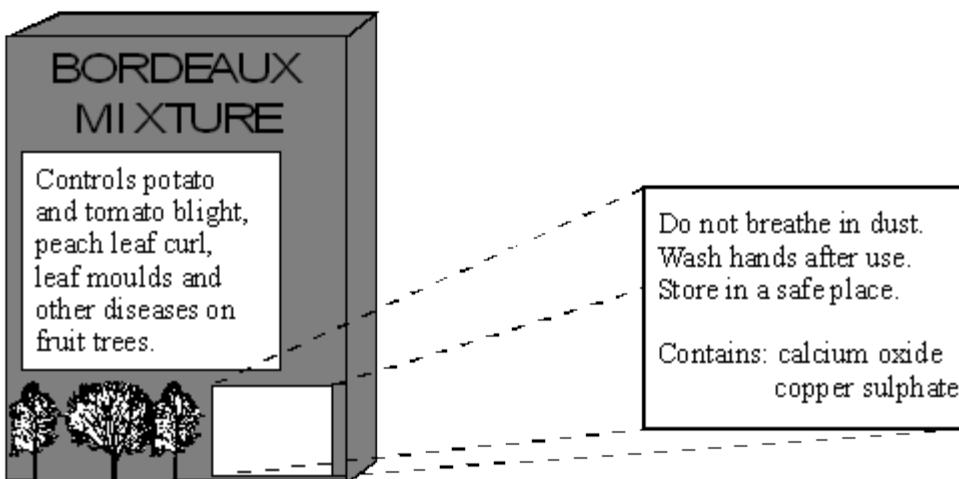
(2)

(Total 10 marks)

23

Bordeaux Mixture controls some fungal infections on plants.

A student wanted to make some Bordeaux Mixture.



(a) The student knew that calcium oxide could be made by heating limestone. Limestone contains calcium carbonate,  $\text{CaCO}_3$ .

(i) Write the word equation for this reaction.

.....

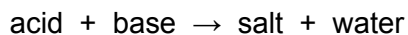
(1)

(ii) What type of reaction is this?

.....

(1)

- (b) The student knew that copper sulphate,  $\text{CuSO}_4$ , could be made by the following general reaction.



- (i) What type of reaction is this?

.....

(1)

- (ii) The base used is copper oxide. Name and give the chemical formula of the acid used.

Name .....

Chemical formula .....

(2)

- (c) The student wrote about how the copper sulphate was made.

“Some of the acid was warmed. Copper oxide was added. The mixture was stirred. More copper oxide was added until no more would react. The mixture was then filtered.”

- (i) Why was the acid warmed?

.....

.....

(1)

- (ii) Copper oxide was added until no more would react. Explain why.

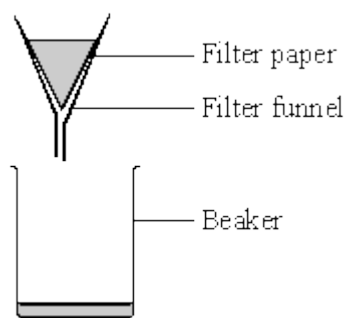
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(2)

(iii) The filtration apparatus is shown.



Describe and explain what happens as the mixture is filtered.

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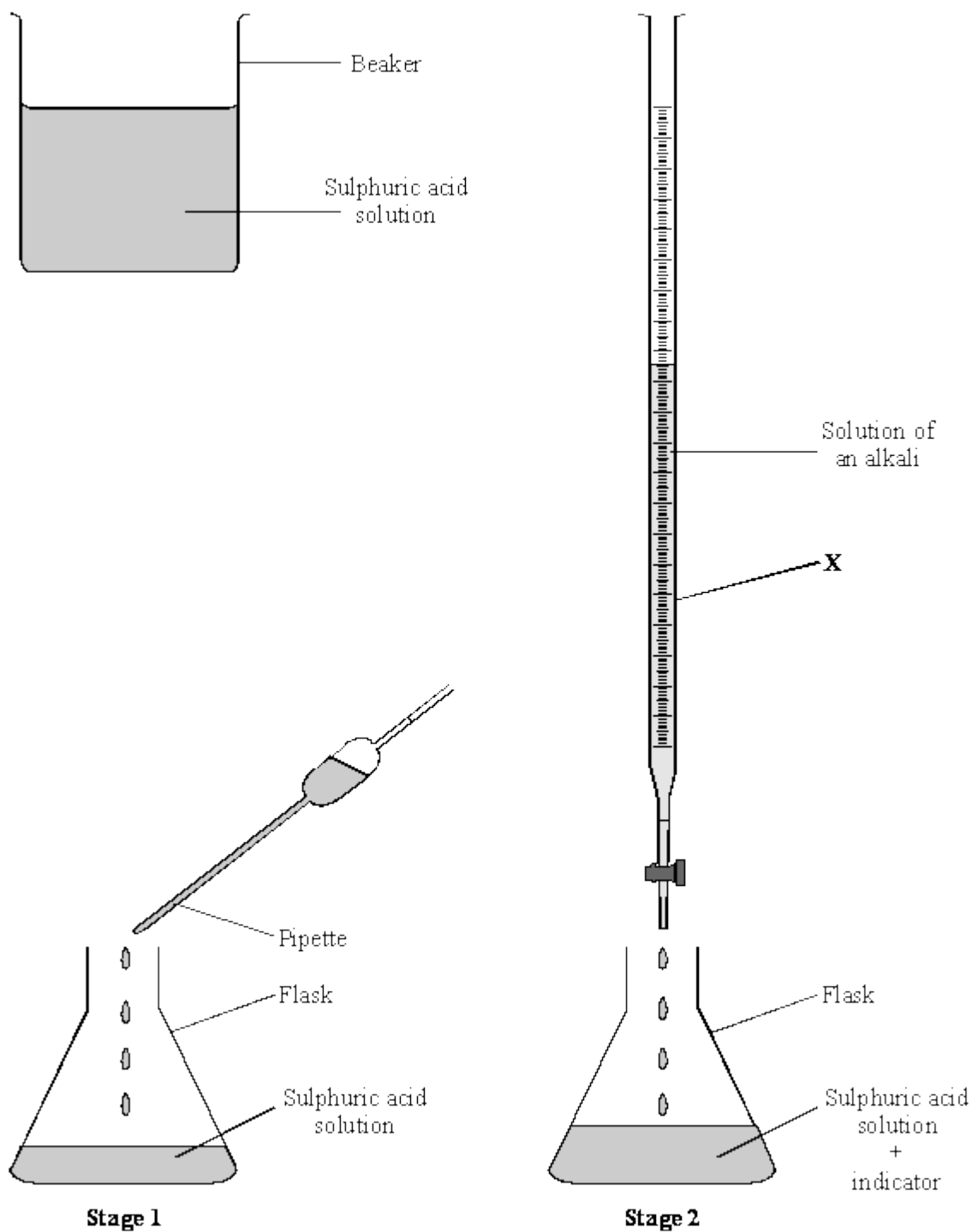
.....

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(2)  
(Total 10 marks)

24

A titration was used to find the concentration of the sulphuric acid solution in the beaker.



**Stage 1** 25.0 cm<sup>3</sup> of the sulphuric acid solution was added to a flask using a pipette.

**Stage 2** A solution of an alkali was added to the acid until the solution was neutral.  
The volume of the alkali was noted.

(a) What would be the pH of the sulphuric acid solution?

.....

(1)

(b) Why was a pipette used instead of a measuring cylinder in **Stage 1**?

.....

(1)

(c) Name the apparatus labelled **X** which is used to add the alkali in **Stage 2**.

.....

(1)

(d) Name an alkali that could be used in **Stage 2**.

.....

(1)

(e) (i) Name an indicator that you could use to find out when the solution was neutral.

.....

(1)

(ii) How would you know that the solution was neutral?

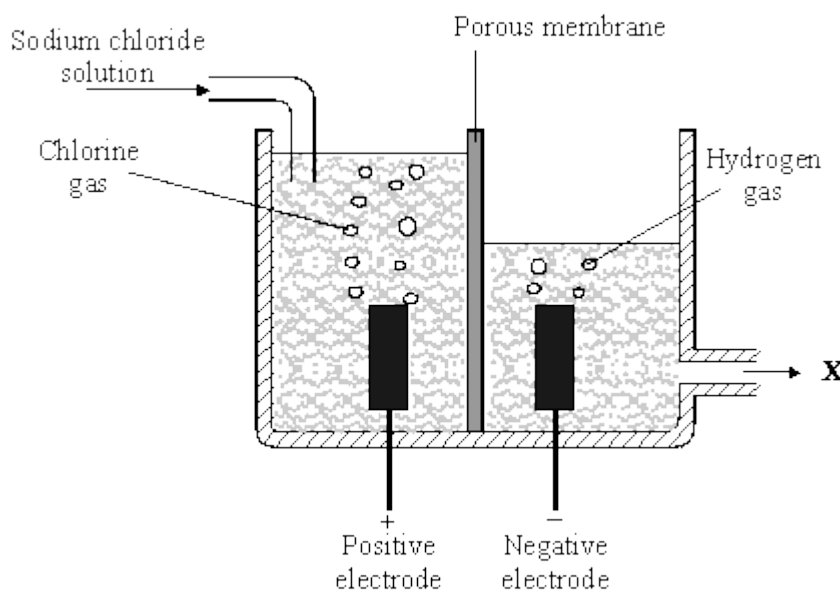
.....

(1)

(Total 6 marks)

25

Sodium chloride solution is a useful raw material for the manufacture of other substances.



(i) What is the name of the process shown?

.....

(1)

- (ii) Chloride ions lose electrons at the positive electrode. What is the name of this type of reaction?

.....

(1)

- (iii) The solution formed at **X** is alkaline. What causes this solution to be alkaline?

.....

.....

.....

(2)

- (iv) Give a balanced ionic equation for the formation of hydrogen gas at the negative electrode.

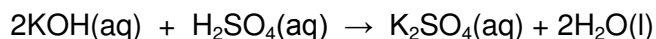
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(3)

(Total 7 marks)

26

A student carried out a titration to find the concentration of a solution of sulphuric acid. 25.0 cm<sup>3</sup> of the sulphuric acid solution was neutralised exactly by 34.0 cm<sup>3</sup> of a potassium hydroxide solution of concentration 2.0 mol/dm<sup>3</sup>. The equation for the reaction is:



- (a) Describe the experimental procedure for the titration carried out by the student.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

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

.....

Number of moles = .....

(2)

(c) Calculate the concentration of the sulphuric acid in mol/dm<sup>3</sup>.

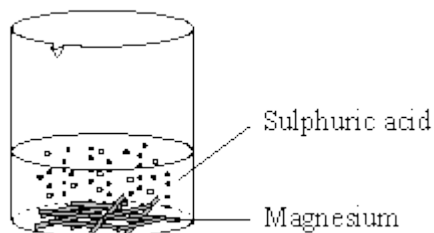
.....  
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Concentration = ..... mol/dm<sup>3</sup>

**(3)**  
**(Total 9 marks)**

**27**

A student tried to make some magnesium sulphate. Excess magnesium was added to dilute sulphuric acid. During this reaction fizzing was observed due to the production of a gas.



(i) Complete and balance the chemical equation for this reaction.



**(3)**

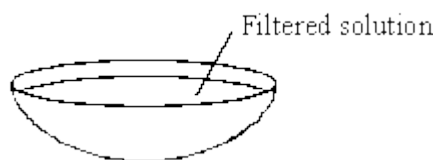
(ii) At the end of the reaction the solution remaining was filtered. Why was the solution filtered?

.....

**(1)**



- (iii) The filtered solution was left in a warm place.



Explain why the filtered solution was left in a warm place.

.....

.....

.....

(2)  
(Total 6 marks)

28

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 .....

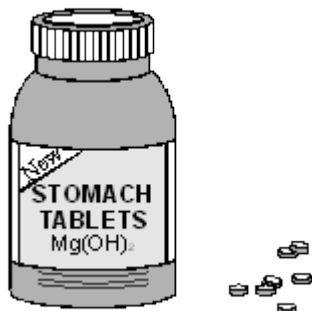
(2)

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

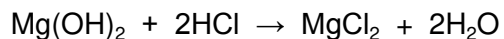


(2)

- (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.

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

(3)

(Total 10 marks)

**29**

Many everyday substances can be classified as acids, bases or salts. For example, car batteries contain sulphuric acid, oven cleaners contain sodium hydroxide and table salt contains sodium chloride.

- (a) A solution of each of these substances was tested with universal indicator.

Solution	Colour of universal indicator
Sulphuric acid ( $\text{H}_2\text{SO}_4$ )	red
Sodium hydroxide ( $\text{NaOH}$ )	purple
Sodium chloride ( $\text{NaCl}$ )	green

- (i) Explain how these universal indicator colours and the corresponding pH values could be used to identify each of these solutions.

.....

.....

.....

.....

.....

**(3)**

- (ii) Name and give the formula of the ion which causes the solution to be acidic.

Name of ion .....

Formula of ion .....

**(2)**

- (b) Sodium chloride can be made by reacting sodium hydroxide with hydrochloric acid in the presence of an indicator.

- (i) What is the name of this type of reaction?

.....

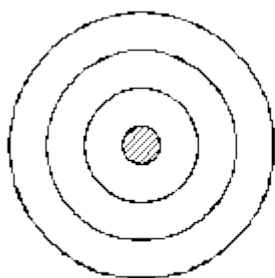
**(1)**

- (ii) Write a balanced chemical equation for this reaction.

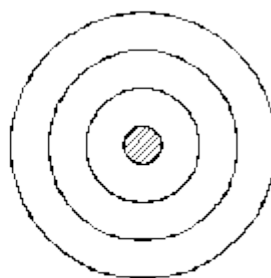
.....(aq) + .....(aq)  $\rightarrow$  .....(aq) + .....(l)

**(2)**

(c) The atomic number for sodium is 11 and for chlorine is 17.



Sodium atom



Chlorine atom

(i) Complete the diagrams to show the electron arrangements for a sodium atom and a chlorine atom.

(2)

(ii) These atoms form different particles by one electron transferring from the sodium atom to the chlorine atom. What is the name given to the particles formed?

.....

(1)

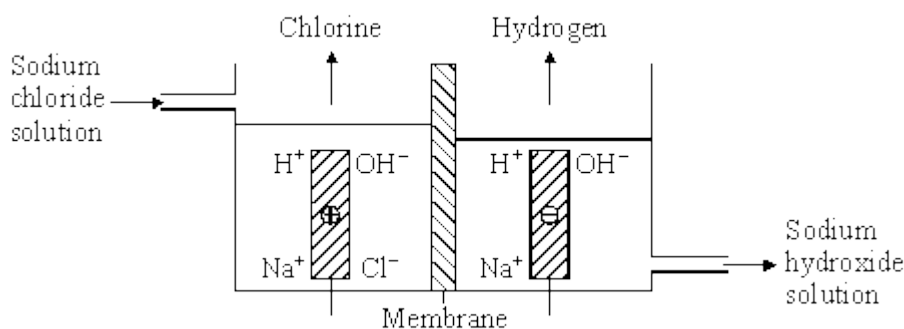
(iii) Why do these sodium and chloride particles bond?

.....

.....

(1)

(d) Sodium chloride solution is electrolysed to form three products, hydrogen, chlorine and sodium hydroxide.



Describe how each of these products are formed.

.....

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.....

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.....

.....

(3)  
(Total 15 marks)

30

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

(a) Describe how this titration is carried out.

.....

.....

.....

.....

.....

(3)

(b) Calculate the concentration of the hydrochloric acid in mol/dm<sup>3</sup>.

Relative atomic masses: H 1; Cl 35.5

.....

Answer = ..... mol/dm<sup>3</sup>

(2)

(c) 10.0 cm<sup>3</sup> of hydrochloric acid were required to neutralise the 25.0 cm<sup>3</sup> 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<sup>3</sup>.

.....

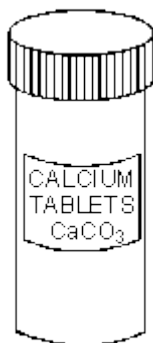
Answer = ..... mol/dm<sup>3</sup>

(2)

(Total 9 marks)

31

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)

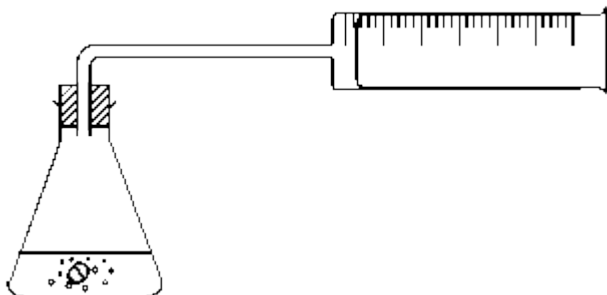
- (ii) The calcium salt that is formed is absorbed during digestion. What is the name of the calcium salt?

.....

.....

(1)

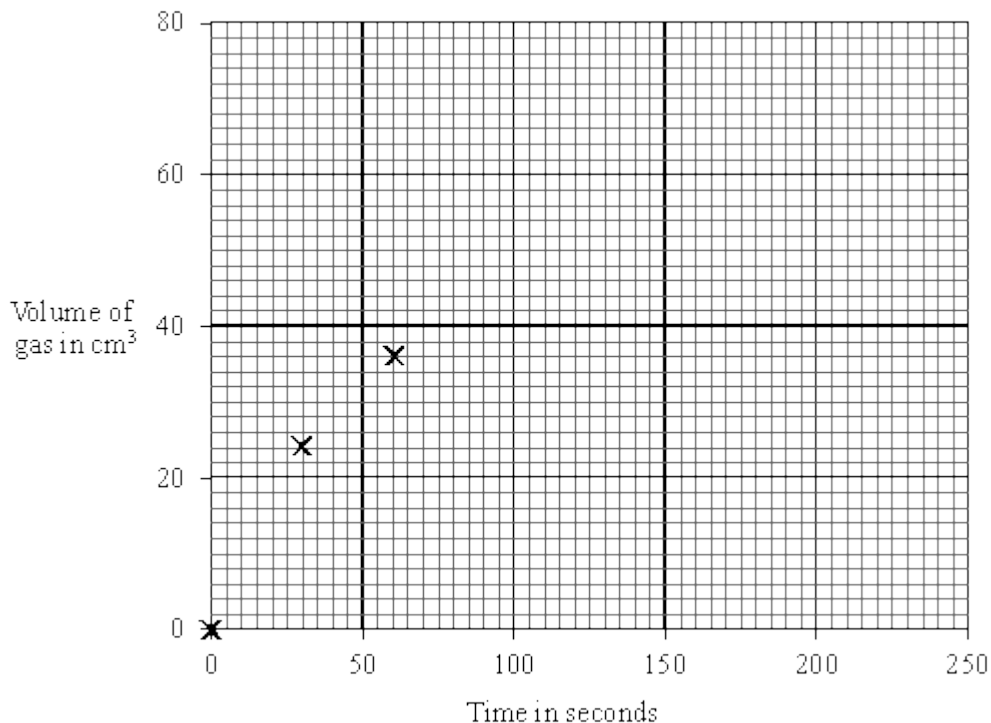
- (b) The volume of carbon dioxide produced by one calcium tablet in the stomach can be found as shown.



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

<b>Time in seconds</b>	0	30	60	90	120	150	180	210	240
<b>Volume of gas in cm<sup>3</sup></b>	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 cm<sup>3</sup> 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.

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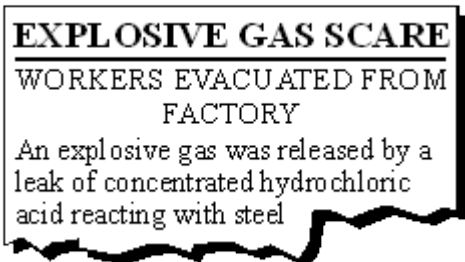
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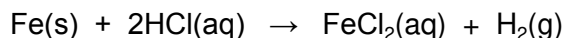
(3)  
(Total 10 marks)

32

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.

.....

.....

.....

.....

.....

(3)



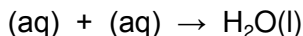
(b) In the factory hydrogen chloride is manufactured by reacting hydrogen with chlorine. Hydrochloric acid is formed when hydrogen chloride forms a solution in water.

(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)

33

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 cm<sup>3</sup> of 0.40 mol/dm<sup>3</sup> 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 cm<sup>3</sup>.

(a) What piece of apparatus would be used to measure 25.0 cm<sup>3</sup> 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.

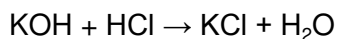
.....

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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/dm<sup>3</sup>

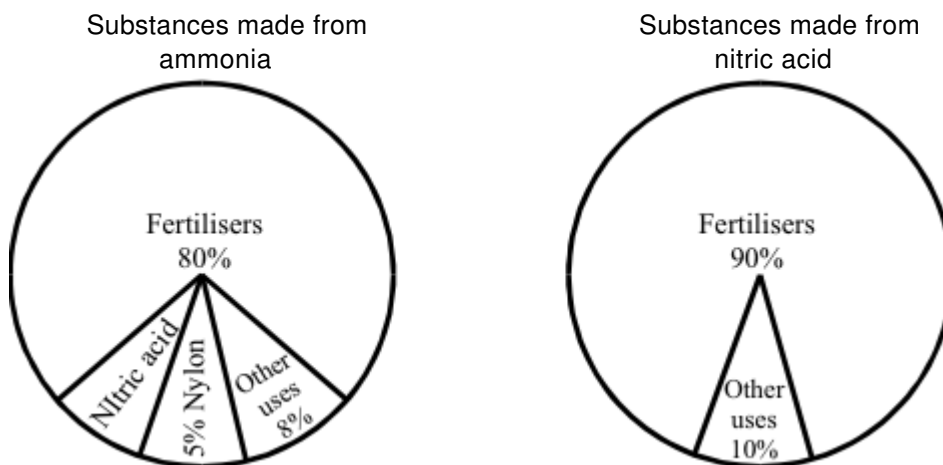
(2)

(Total 6 marks)

34

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.



- (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.

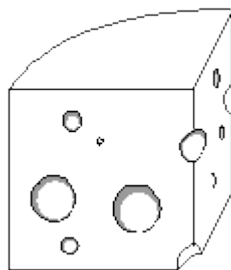
Name the piece of equipment you could put into the solution to prove that the reaction is exothermic.

.....

(1)  
(Total 9 marks)

**35**

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).

.....

(1)

(Total 6 marks)

**36**

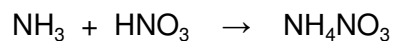
Ammonium nitrate is an important fertiliser. It is made by reacting nitric acid with the alkali ammonia.

- (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)

37

- (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.

*DOSEAGE: 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.

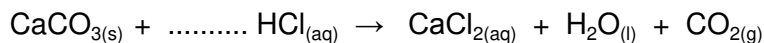
40 cm<sup>3</sup> of dilute hydrochloric acid were placed in a conical flask. The flask was placed on a direct reading balance. Two *Antacid* tablets were quickly added to the flask. The apparatus was weighed immediately. At the same time, a stop clock was started. The mass was recorded every half minute 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".

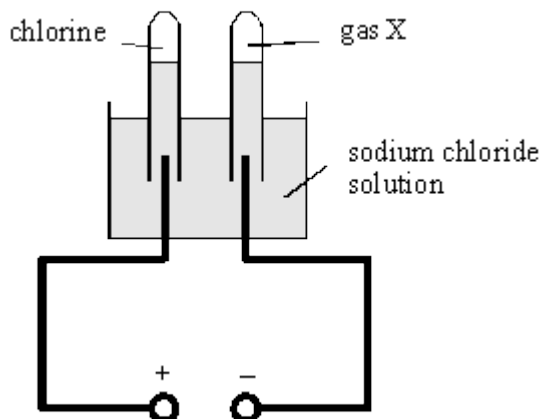
(2)

(Total 12 marks)



38

- (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?

.....

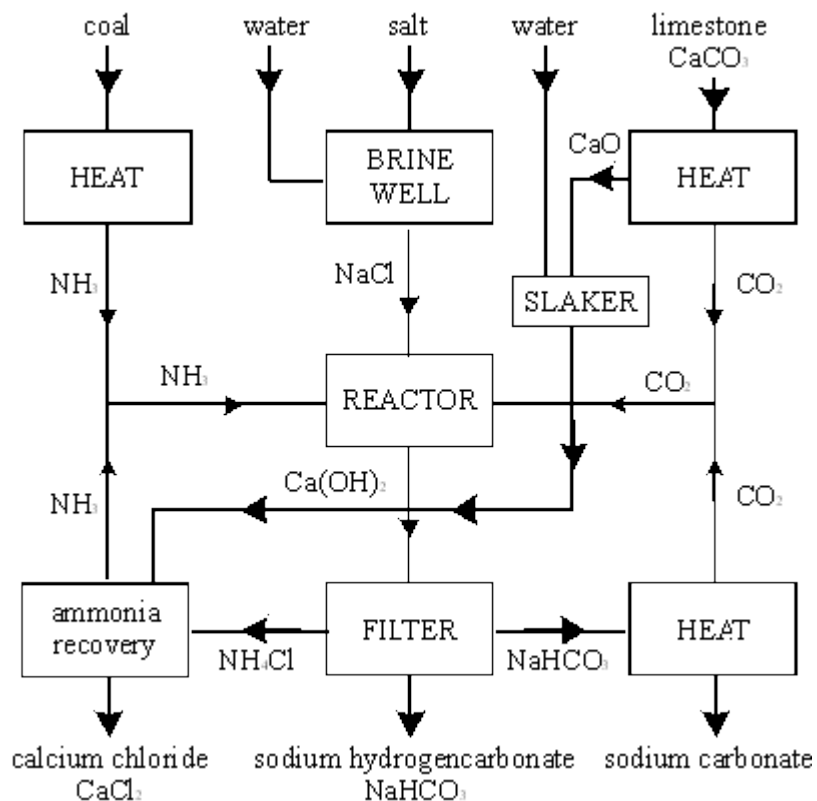
(1)

- (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)****39**

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.

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

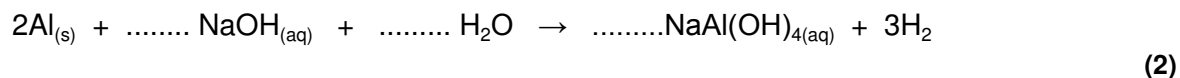
(3)

(Total 13 marks)

40

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.



- (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)

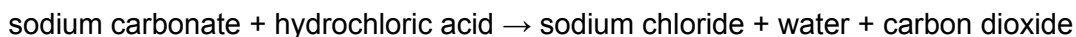
- (iii) Name the compound formed when these ions react with each other.

..... (1)

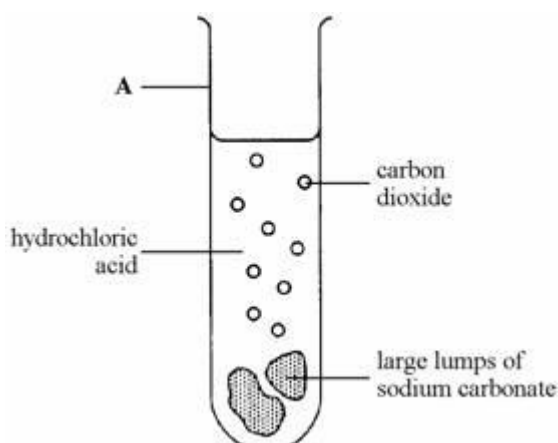
(Total 6 marks)

41

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)            **NaCO<sub>3</sub>**            **NaCl**            **Na<sub>2</sub>CO<sub>3</sub>**            **Na<sub>2</sub>Cl**

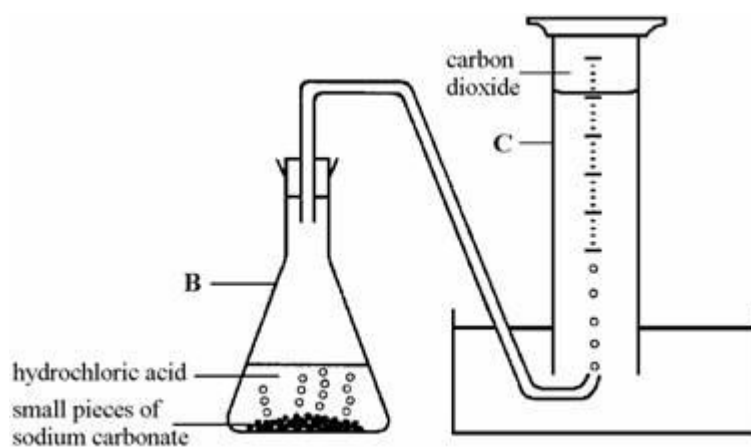
Use the Data Sheet to help you choose the correct formula from the list for:

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.

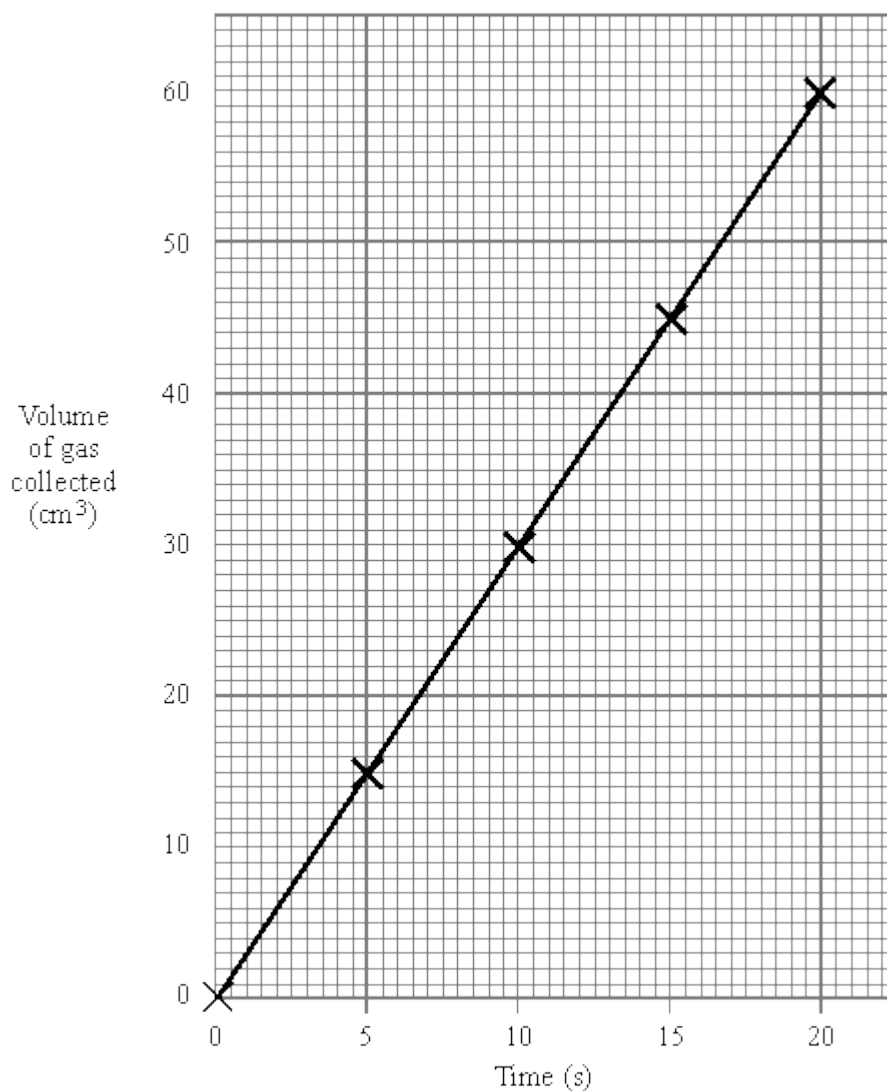
.....

.....

.....

(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)

42

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

**ethanoic acid                      hydrochloric acid                      nitric acid                      sulphuric acid**

.....

(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)



43

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)**

**44**

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

..... acid

(1)

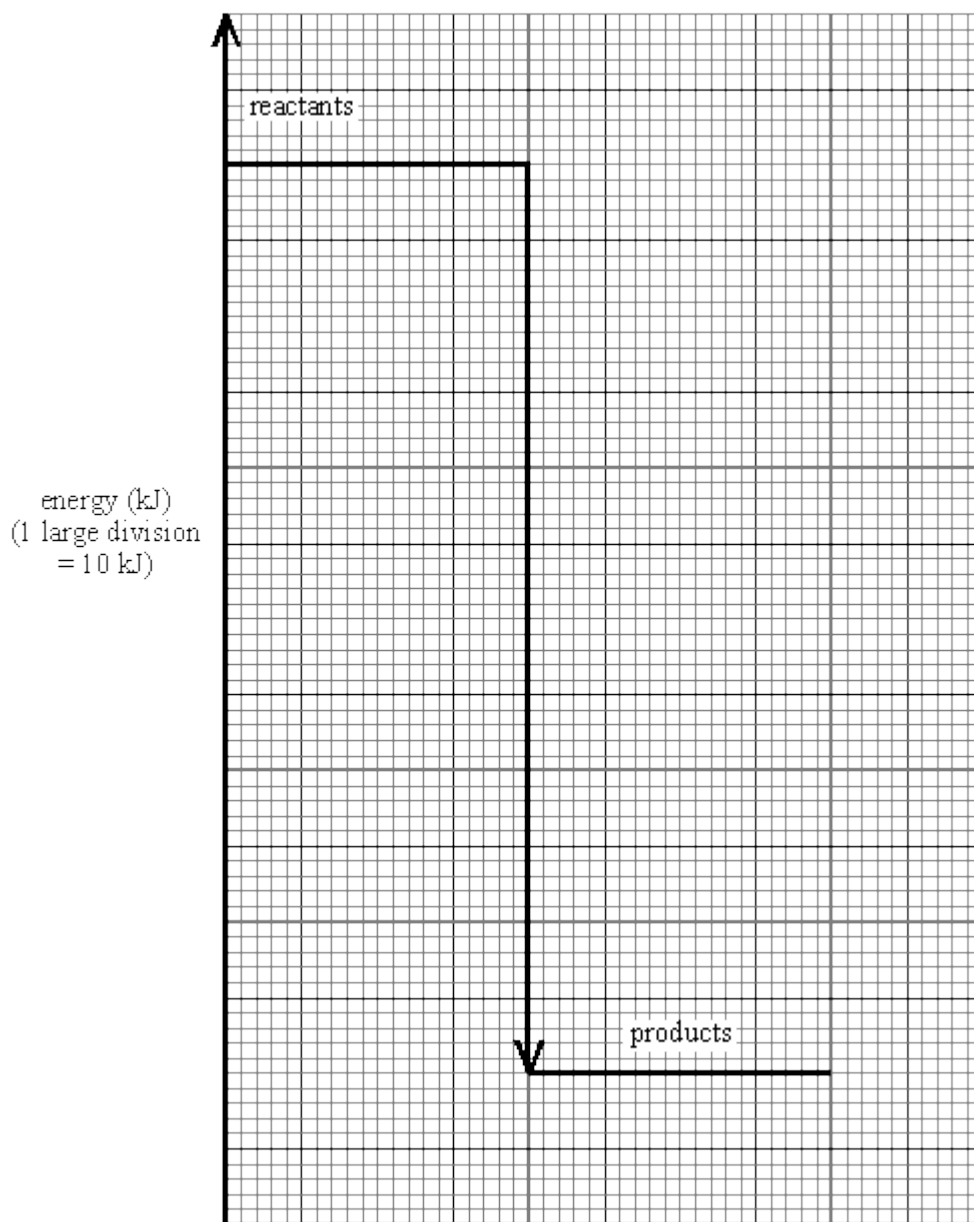
(ii) Use the table on the Data Sheet to help you to write the formula of sodium sulphate.

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)****45**

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.

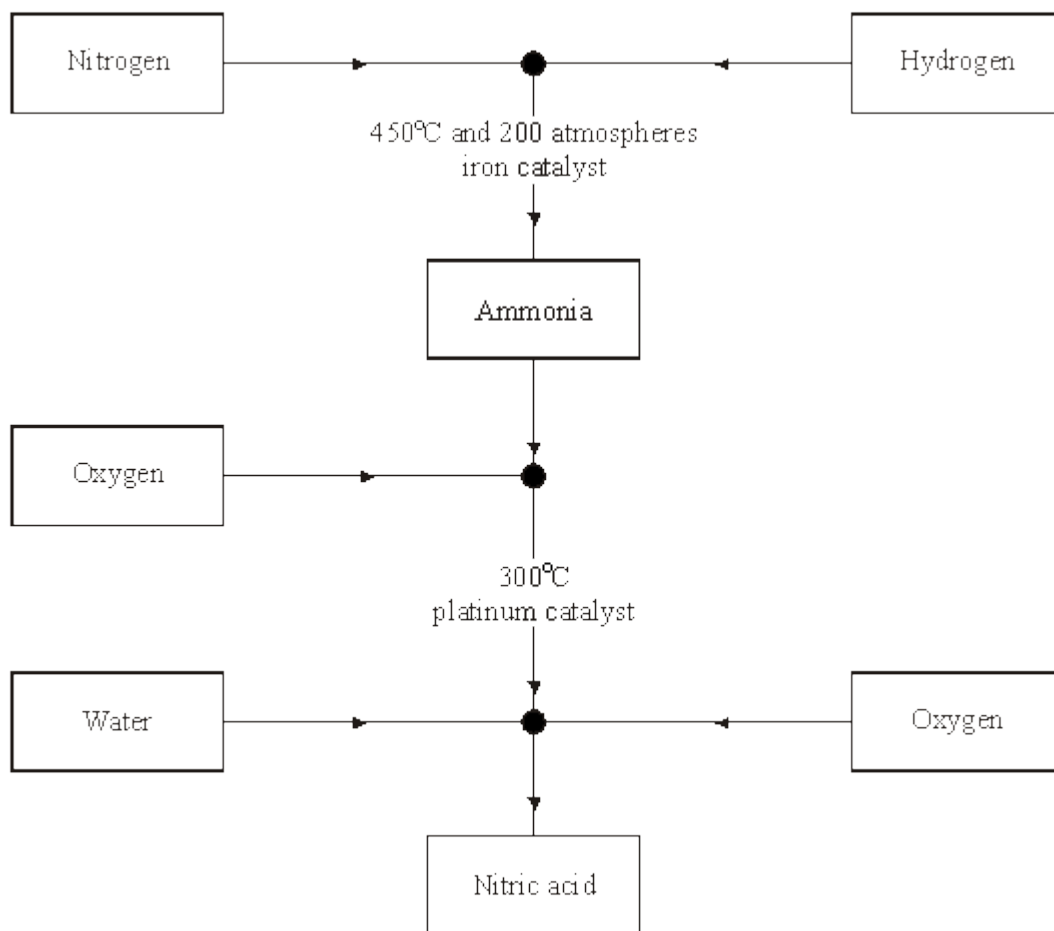
The first one has been done for you.

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

**(Total 4 marks)**

46

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.

.....

.....

.....

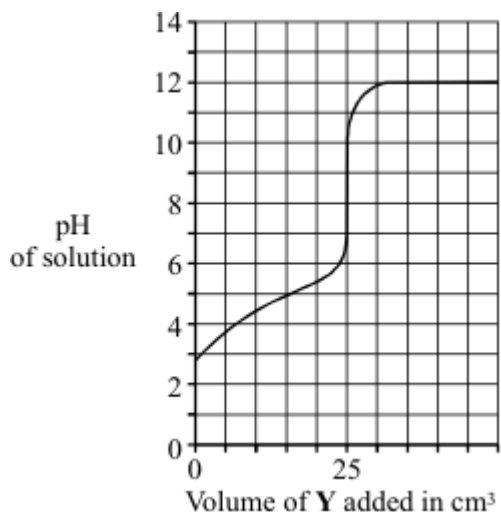
.....

(2)

(Total 7 marks)

47

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)

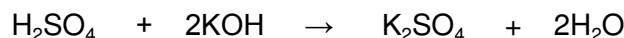
- (iii) What volume of solution **Y** was needed to react with all of the substance in solution **X**?

..... cm<sup>3</sup>

(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?

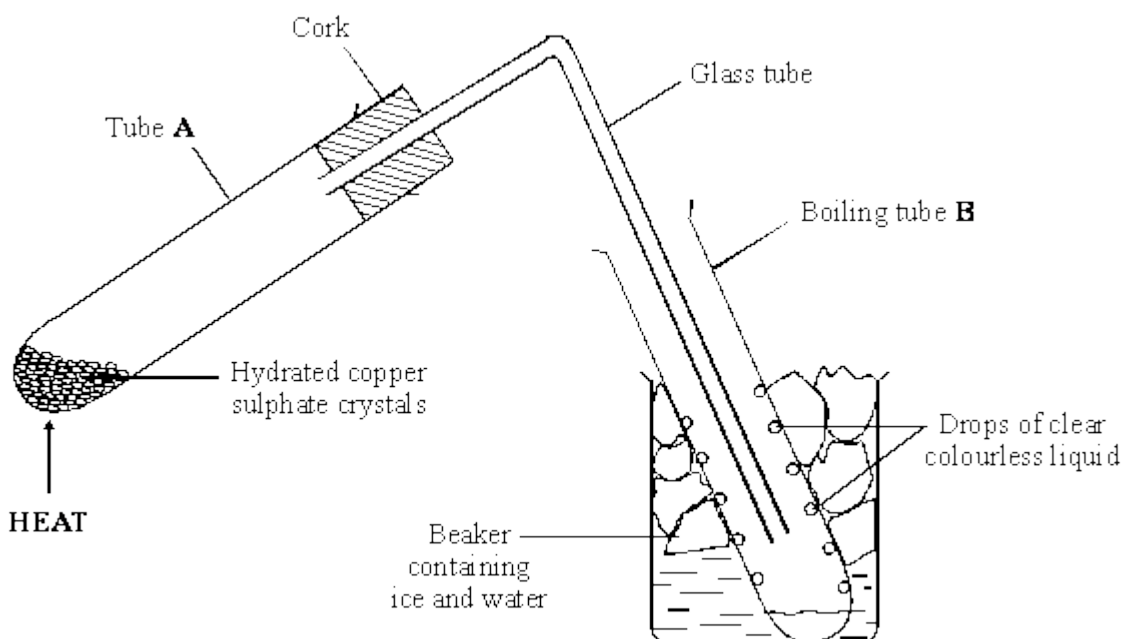
.....

(1)

(Total 5 marks)

48

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)



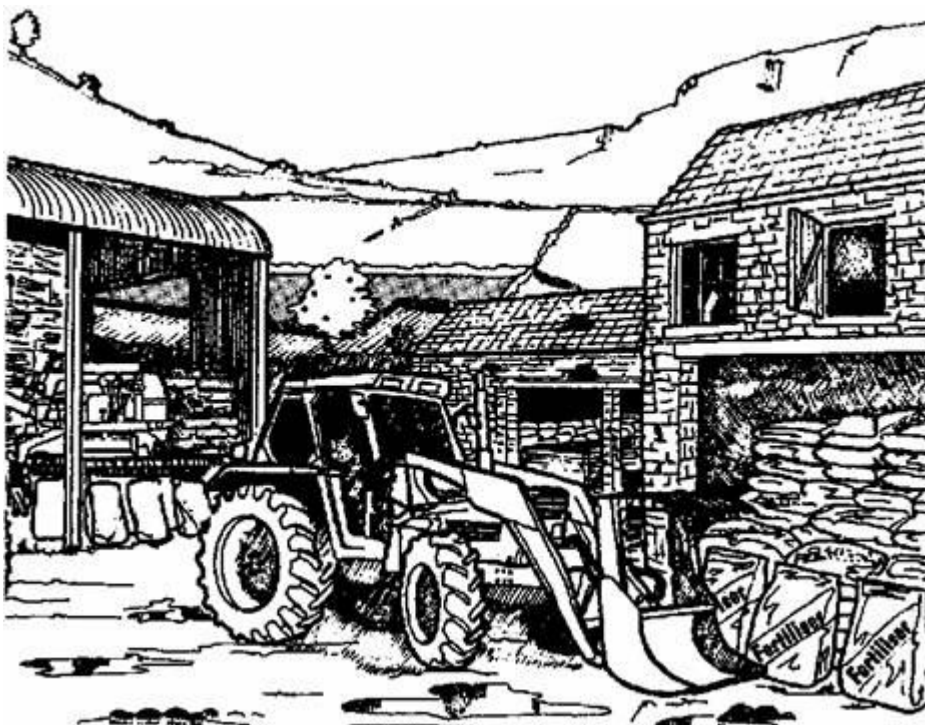
- (f) Copper sulphate can be made from black copper oxide by reacting it with an acid. Name the acid.

.....

(1)  
(Total 10 marks)

49

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?

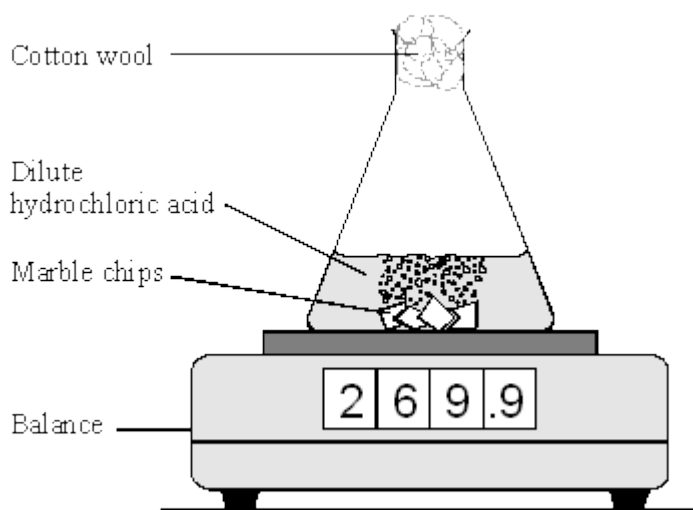
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(1)

(Total 4 marks)

50

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  $\text{CaCO}_3$ . The salt formed is calcium chloride,  $\text{CaCl}_2$ .



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

.....

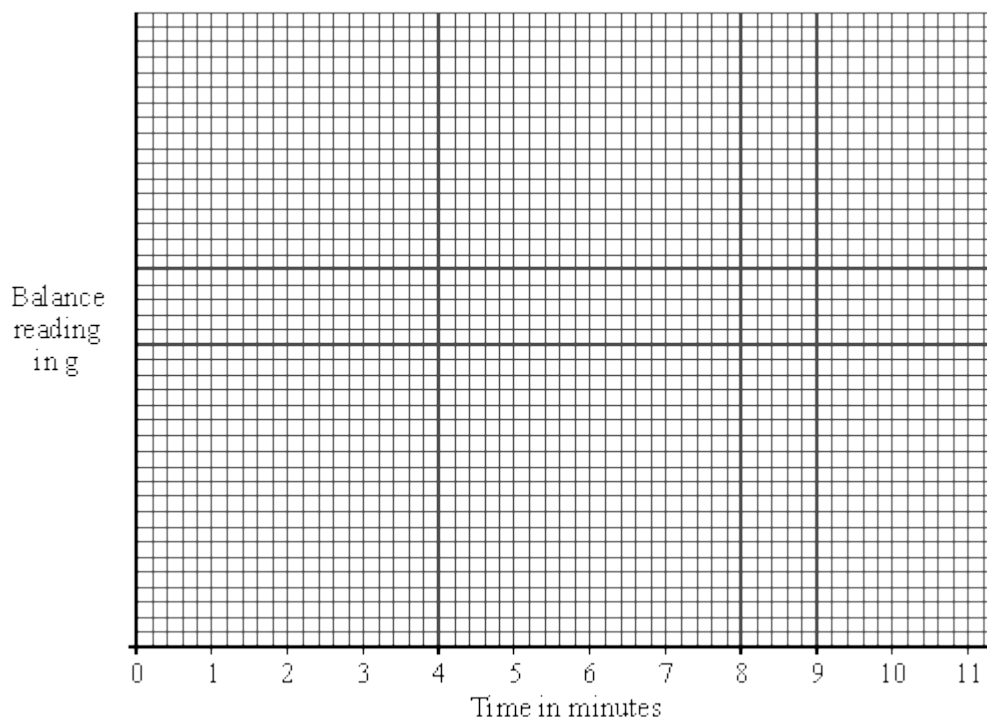
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(2)

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.



- (ii) Continue the graph you have drawn to show the expected reading after 11 minutes. (3)
- (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. (1)

(2)  
(Total 8 marks)

51

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?

.....

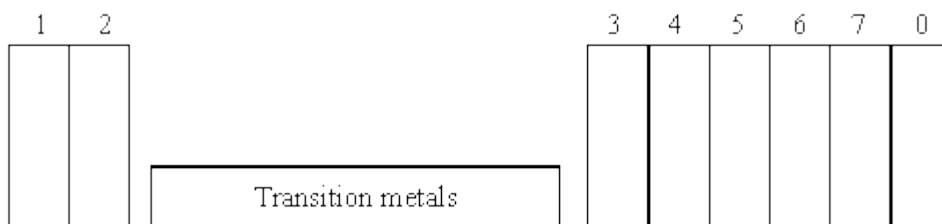
(1)

(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.

1 .....

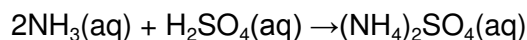
2 .....

(2)

(Total 10 marks)

52

- (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 $\text{NH}_3$ ?	.....
What is the name of the substance with the formula $\text{H}_2\text{SO}_4$ ?	.....

(3)

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

.....

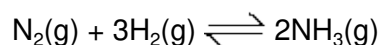
(1)

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

.....

(1)

- (b)
- $\text{NH}_3$
- 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 (
- $\text{N}_2$
- )?

.....

(1)

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

.....

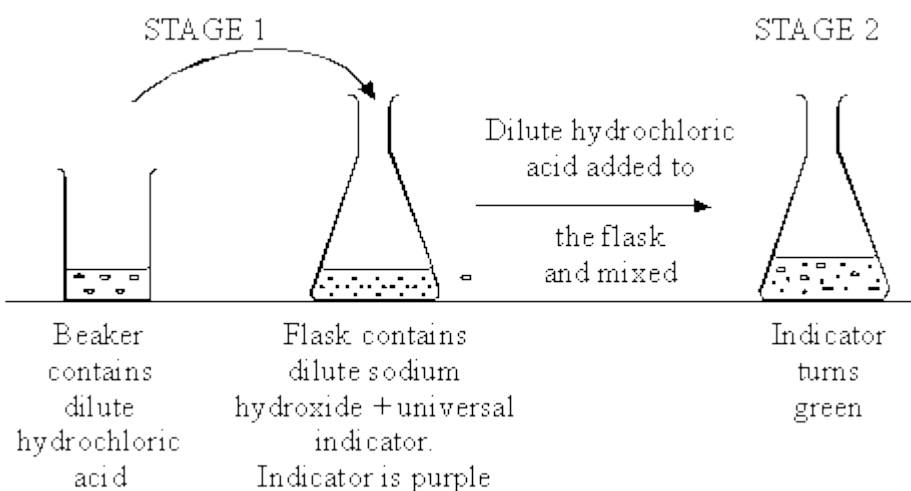
.....

.....

(2)  
(Total 10 marks)

53

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.

.....

.....

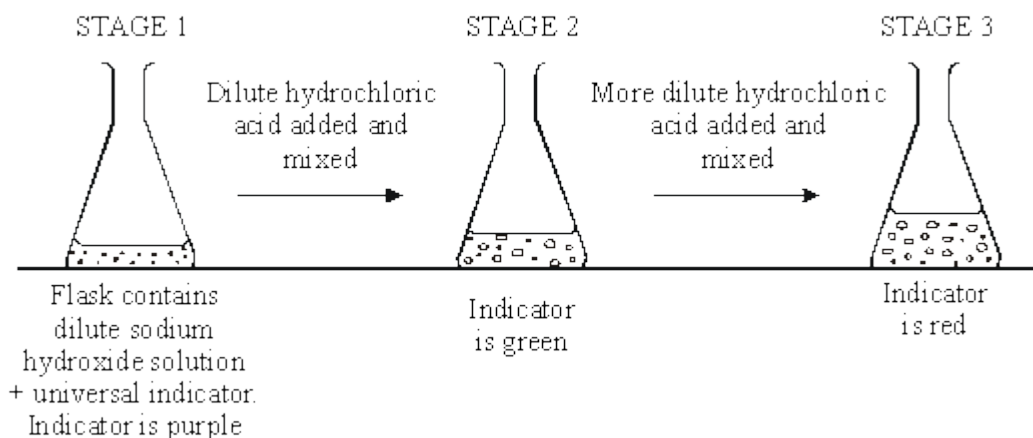
.....

.....

(3)  
(Total 4 marks)

**54**

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)

**55**

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.

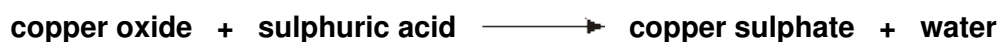
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(1)

(Total 2 marks)

56

Here is a word equation for a chemical reaction.



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

.....

.....

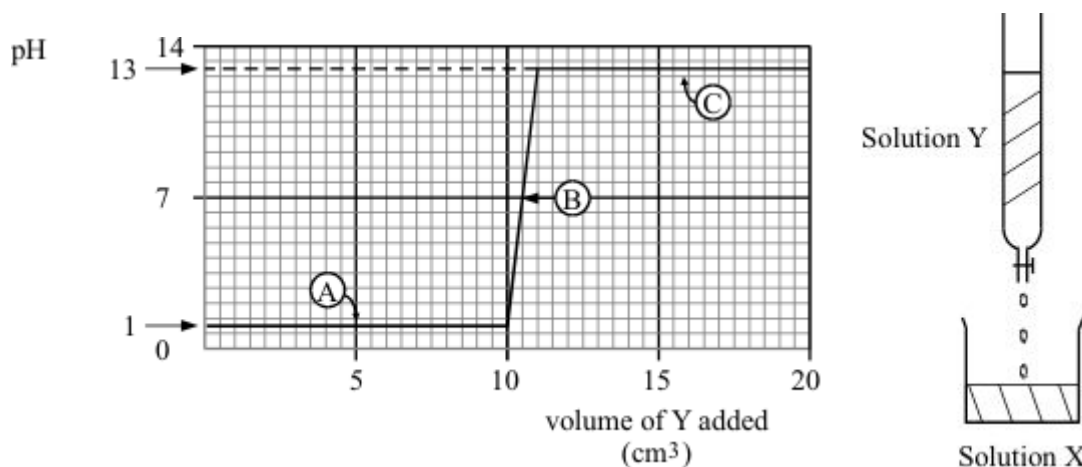
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(Total 4 marks)

57

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)**