AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.4.2 REACTIONS OF ACIDS (PACK 3)

SCORE	PERCENTAGE
/247	%

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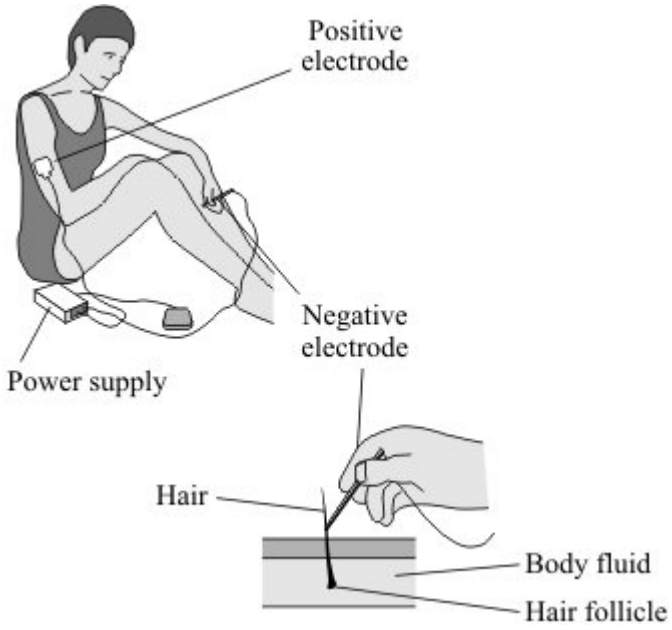
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Q1.

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.

negative	**neutral**	**positive**

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 _____ .

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(1)

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

_____

_____

(1)

(Total 4 marks)

Q2.

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

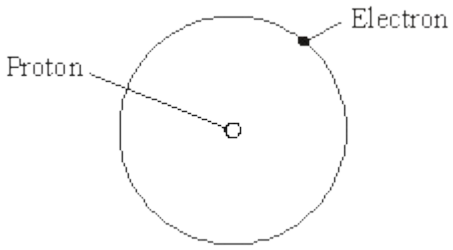
These ions can be represented as $H^+(aq)$.

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.

The word *weak* means that the acid	has a low boiling point.
	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.

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The results are shown in the table.

Acid	pH	Volume of gas in cm^3
A	2	18
B	5	6
C	1	24
D	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.

H^- O^- OH^-

(1)

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

A solution with more hydrogen ions than hydroxide ions is

acidic.

alkaline.

neutral.

(1)

(Total 7 marks)

Q3.

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.

$$Cl_2(g) + H_2O(l) \rightleftharpoons 2H^+(aq) + OCl^-(aq) + Cl^-(aq)$$

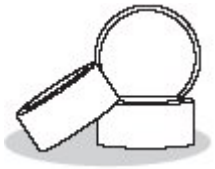
An acidic solution is produced when chlorine reacts with water.

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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 $CaCl_2O_2$

(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 (Cr^{3+}) from water is represented by this equation.

$$Cr^{3+}(aq) + 3OH^-(aq) \rightarrow Cr(OH)_3(s)$$

(i) What type of substance would be added to the water to provide the OH^- ions?

_____

_____

(1)

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(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?

_____

_____

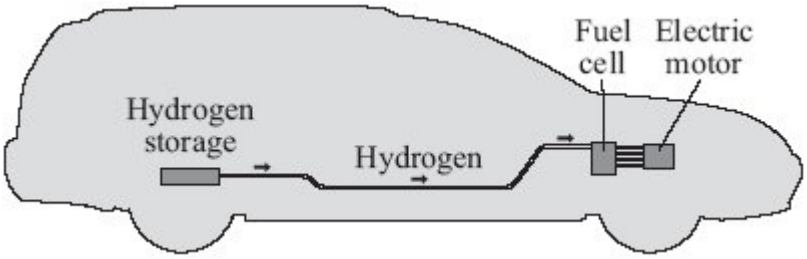
(1)

(Total 9 marks)

Q4.

Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



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.

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(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.

_____ $Li + N_2 \rightarrow$ _____ Li_3N

(1)

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

$$Li_3N + 2H_2 \rightleftharpoons LiNH_2 + 2LiH$$

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 (Li^+) and nitride ions (N^{3-}).

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

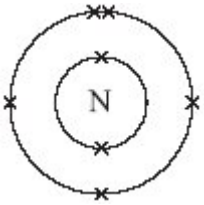
Explain why.

_____

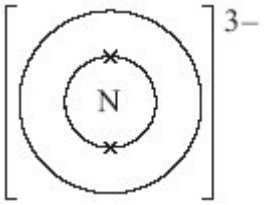
_____

(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 (N^{3-}).



(1)

(Total 8 marks)

Q5.



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 / magnesium | ions.

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sulfate

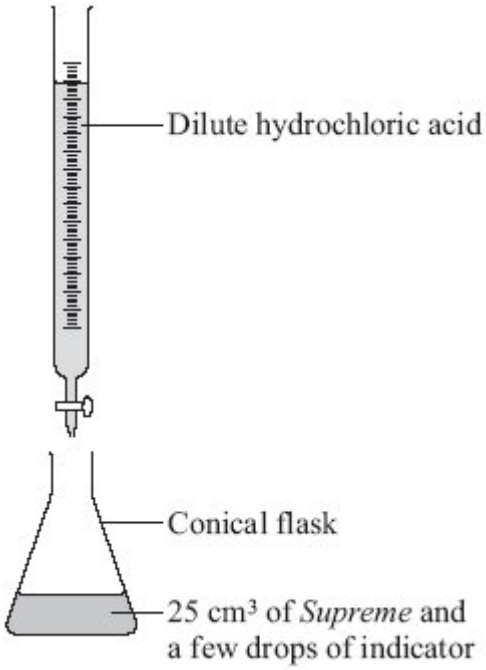
(1)

(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^3 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.

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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)

Q6.

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*.

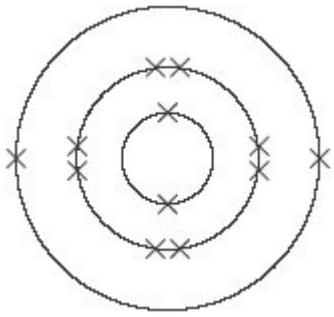
Complete the following sentence using the correct words from the box.

gives out heat	**stores heat**	**takes in heat**

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?

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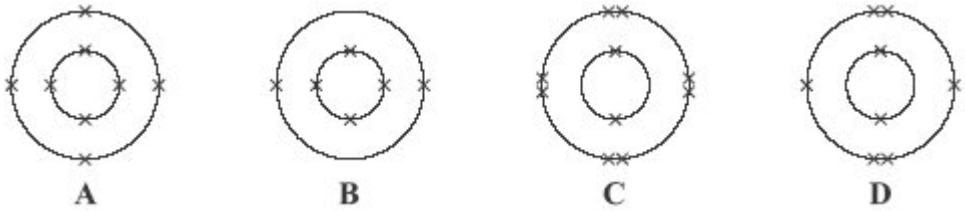
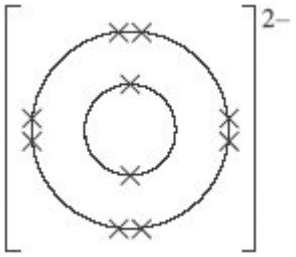


Diagram _____

(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?

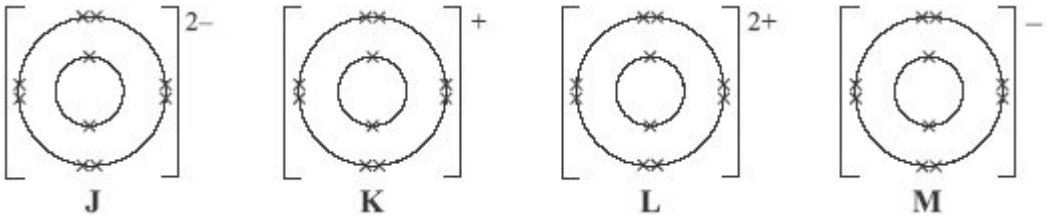


Diagram _____

(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)

Q7.

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

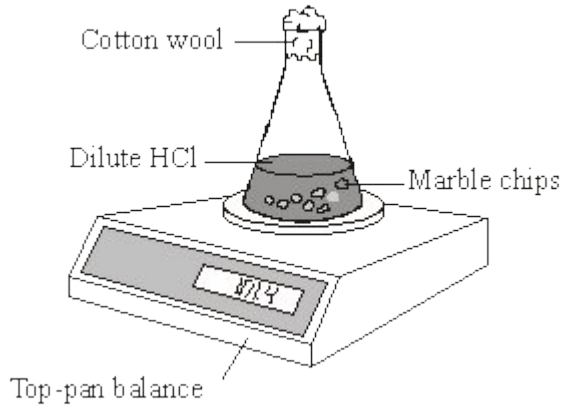
The student used an excess of marble.

The reaction can be represented by this equation.

$CaCO_3$ (s) + 2HC1 (aq) → $CaC1_2$ (aq) + H_2O (l) + CO_2 (g)

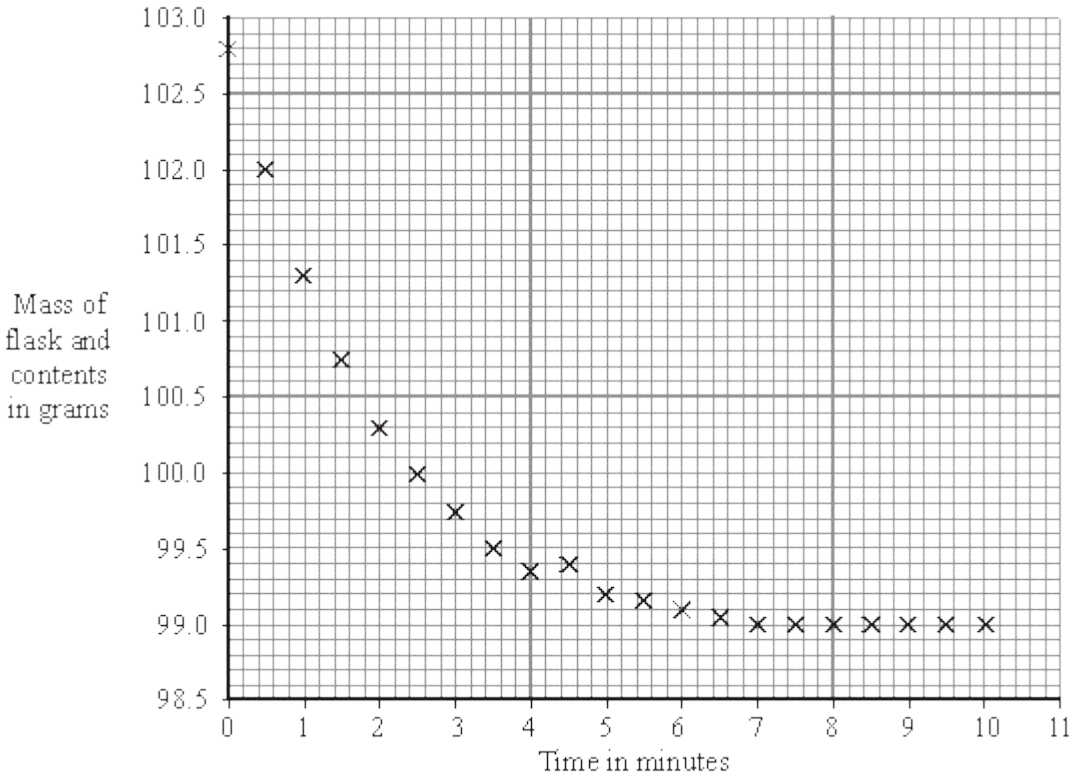
The student used the apparatus shown in the diagram.

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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)

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(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)

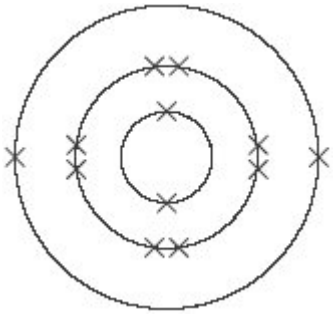
Q8.

(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

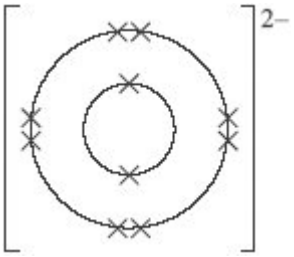
Draw a similar diagram to show the electronic structure of an oxygen atom.
The atomic (proton) number of oxygen is 8.

(1)

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

The diagram shows the electronic structure of an oxide ion.

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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.

hydrochloric acid + magnesium oxide → _____ + water.

(1)

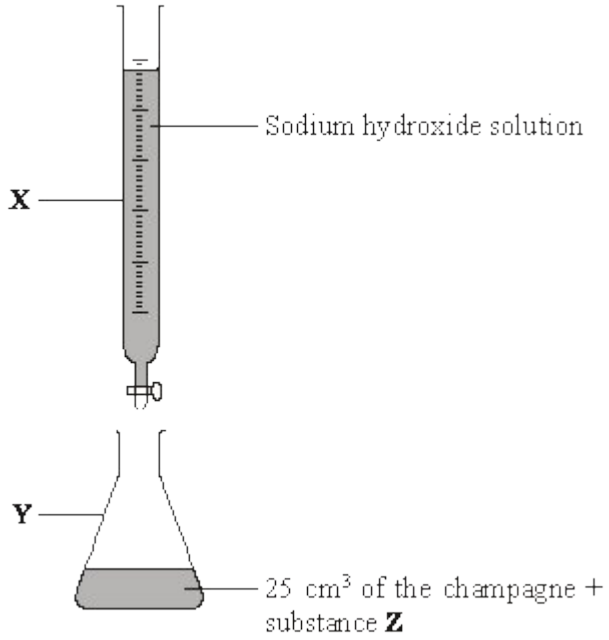
(Total 6 marks)

Q9.

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^3 of the champagne.

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(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)

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(iii) The name of this method of analysis is

distillation
filtration
titration

(1)

(c) 250 cm^3 of this champagne were found to contain 1 g of acid.

Calculate the mass of acid in 750 cm^3 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)

Q10.

This label was taken from a cola drink.

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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	(✓)

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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.

$H^+ + OH^- \rightarrow$ _____

(1)

(Total 5 marks)

Q11.

Copper sulfate ($CuSO_4$) is a salt that has many uses.

An aqueous solution of copper sulfate can be made by reacting copper oxide (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)

Q12.

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**

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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^+	NH_4^+	NO_3^-	O^{2-}	OH^-

The ion that makes solutions acidic is _____ .

(1)

(Total 4 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:

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- 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.

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**

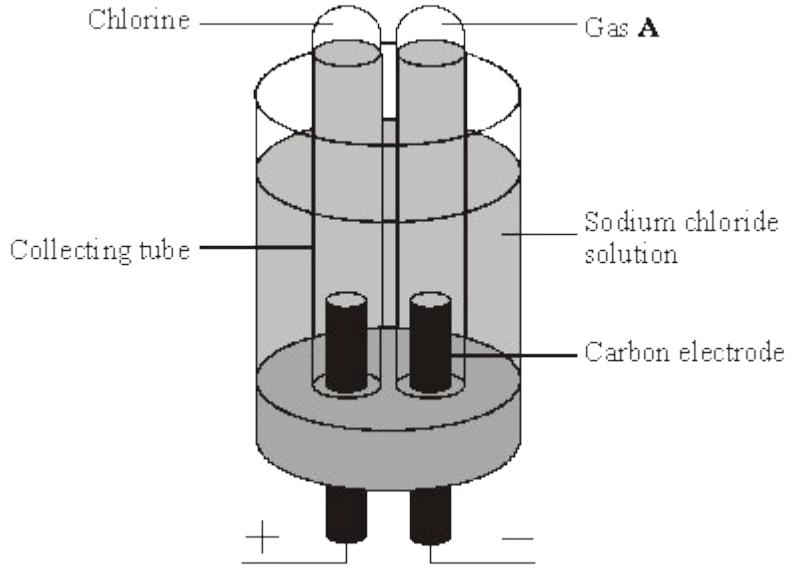
ammonia + _____ → ammonium nitrate + water

_____ + hydrochloric acid → potassium chloride + _____

(Total 3 marks)

Q15.

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)

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(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.

_____

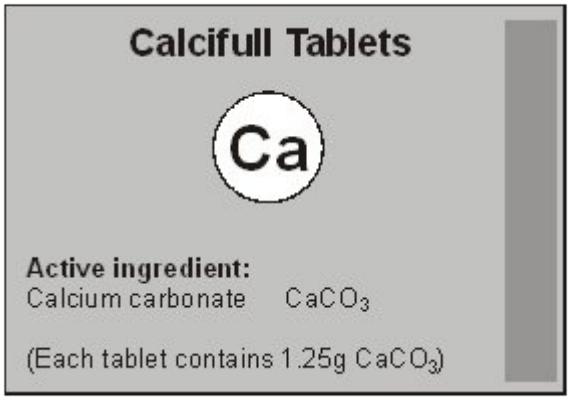
_____

(1)

(Total 6 marks)

Q16.

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.

_____

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_____

Relative formula mass = _____

(2)

(b) Calculate the percentage of calcium in calcium carbonate, $CaCO_3$.

_____

_____

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).

$$CaCO_3\ (s) + 2HCl\ (aq) \rightarrow CaCl_2\ (aq) + H_2O\ (l) + CO_2\ (g)$$

Suggest why the patient may suffer from 'wind'.

_____

_____

(1)

(Total 7 marks)

Q17.

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.

$$SiO_2\ (s) + 2Mg\ (s) \rightarrow 2MgO\ (s) + Si\ (s)$$

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

Relative atomic masses: O = 16; Si = 28

_____

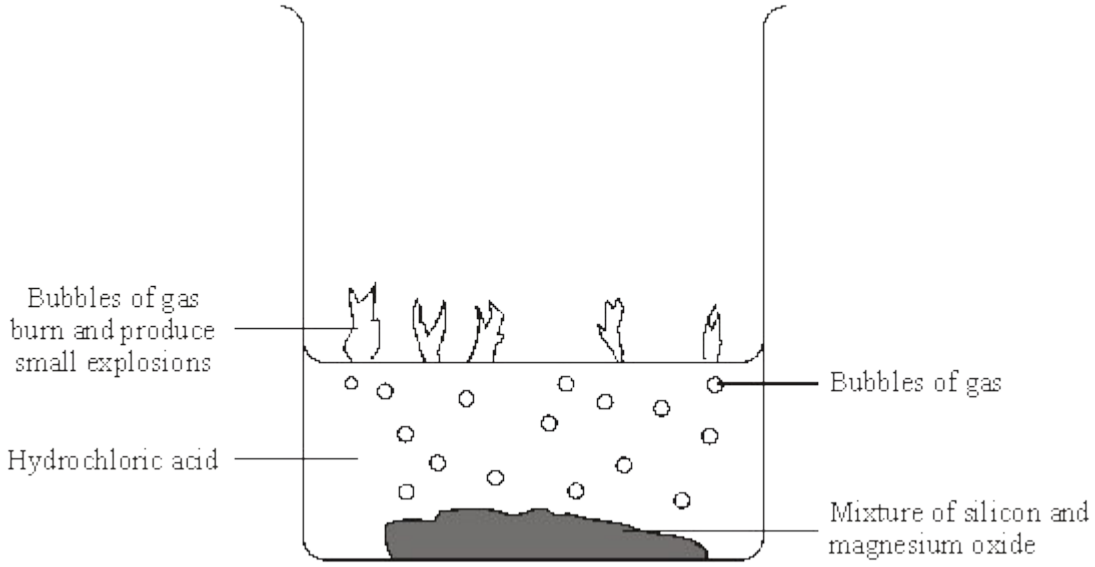
_____

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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 ($MgCl_2$) solution and water.

magnesium oxide + hydrochloric acid → 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 SiH_4. The structure of this molecule is similar to methane, CH_4.

Draw a diagram to show the bonding in a molecule of SiH_4. Represent the electrons as dots and crosses and only show the outer shell (energy level) electrons.

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(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

_____

_____

_____

_____

_____

_____

_____

(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	**A**
		slow	**B**
	low	fast	**C**
		slow	**D**
The energy needed to break existing bonds is greater than the energy released from forming new bonds	high	fast	**E**
		slow	**F**
	low	fast	**G**
		slow	**H**

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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_____

_____

_____

_____

_____

_____

_____

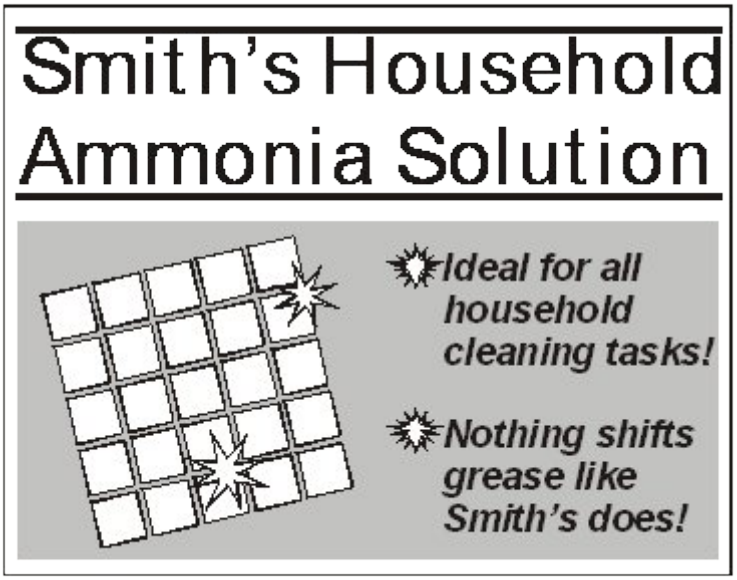
_____

(4)

(Total 15 marks)

Q18.

This label has been taken from a bottle of household ammonia solution.



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^3 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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_____

_____

_____

_____

_____

_____

(4)

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

The balanced symbol equation which represents this reaction is

$$NH_3(aq) + HNO_3(aq) \rightarrow NH_4NO_3(aq)$$

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)

Q19.

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.

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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)

Q20.

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

_____

_____

_____

_____

_____

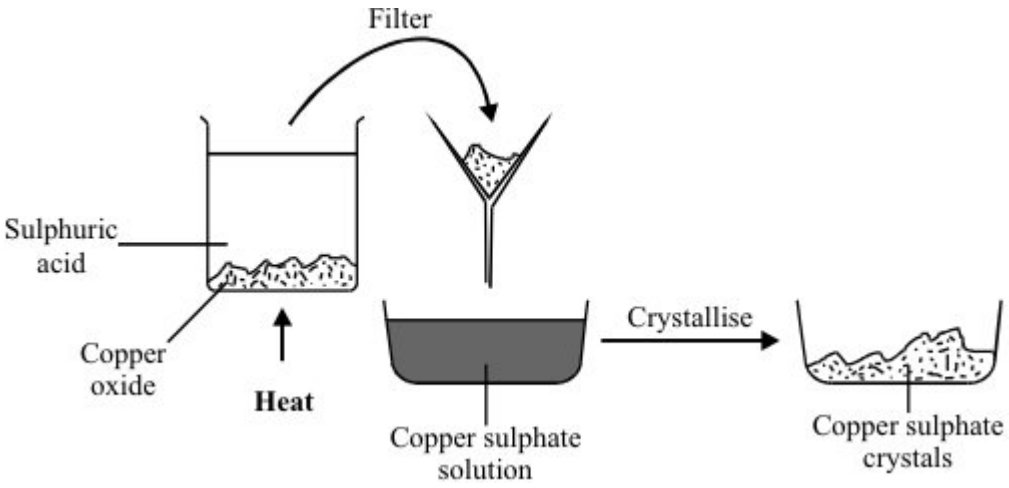
_____

(Total 3 marks)

Q21.

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

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(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.

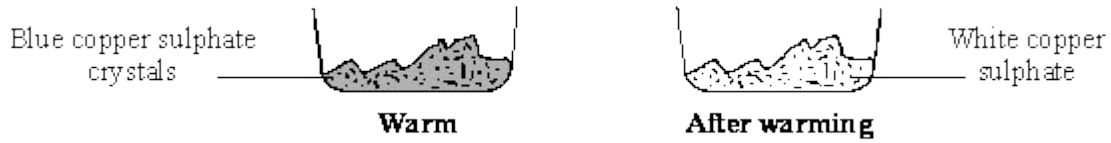
$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$

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)

Q22.

(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**.

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(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.

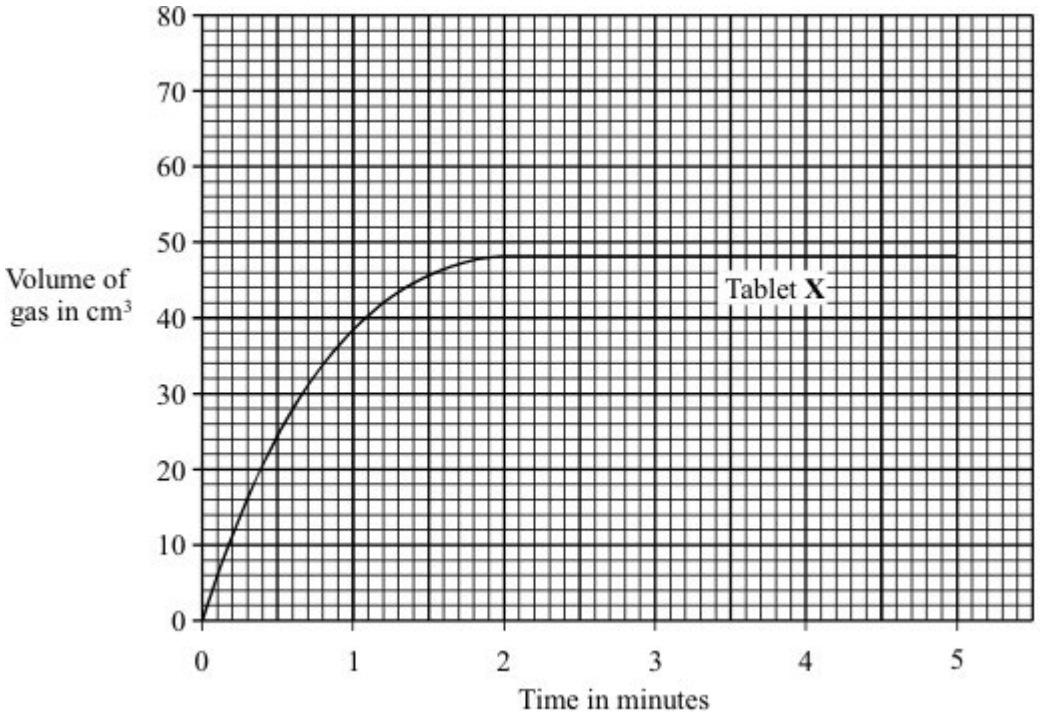
_____

(1)

(b) The student first reacted tablet **X** and then tablet **Y**, with 100 cm^3 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.

Time in minutes	0	1	2	3	4	5
Volume of gas in cm^3 Tablet X	0	38	48	48	48	48
Volume of gas in cm^3 Tablet Y	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?

_____

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_____

(1)

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

_____

_____

_____

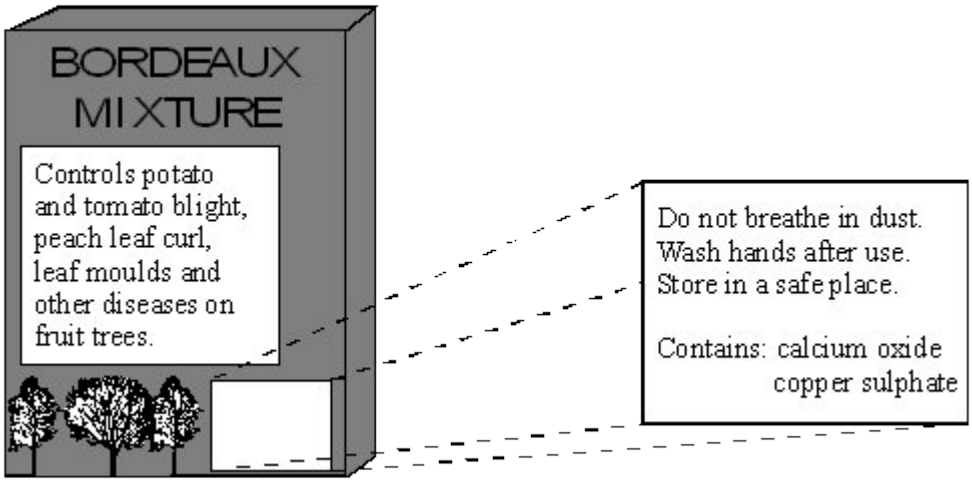
(2)

(Total 10 marks)

Q23.

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, $CaCO_3$.

(i) Write the word equation for this reaction.

_____

(1)

(ii) What type of reaction is this?

_____

(1)

(b) The student knew that copper sulphate, $CuSO_4$, could be made by the following general reaction.

acid + base → salt + water

(i) What type of reaction is this?

_____

(1)

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(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.

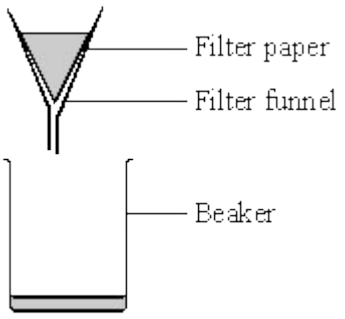
_____

_____

_____

(2)

(iii) The filtration apparatus is shown.



Describe and explain what happens as the mixture is filtered.

_____

_____

_____

_____

_____

_____

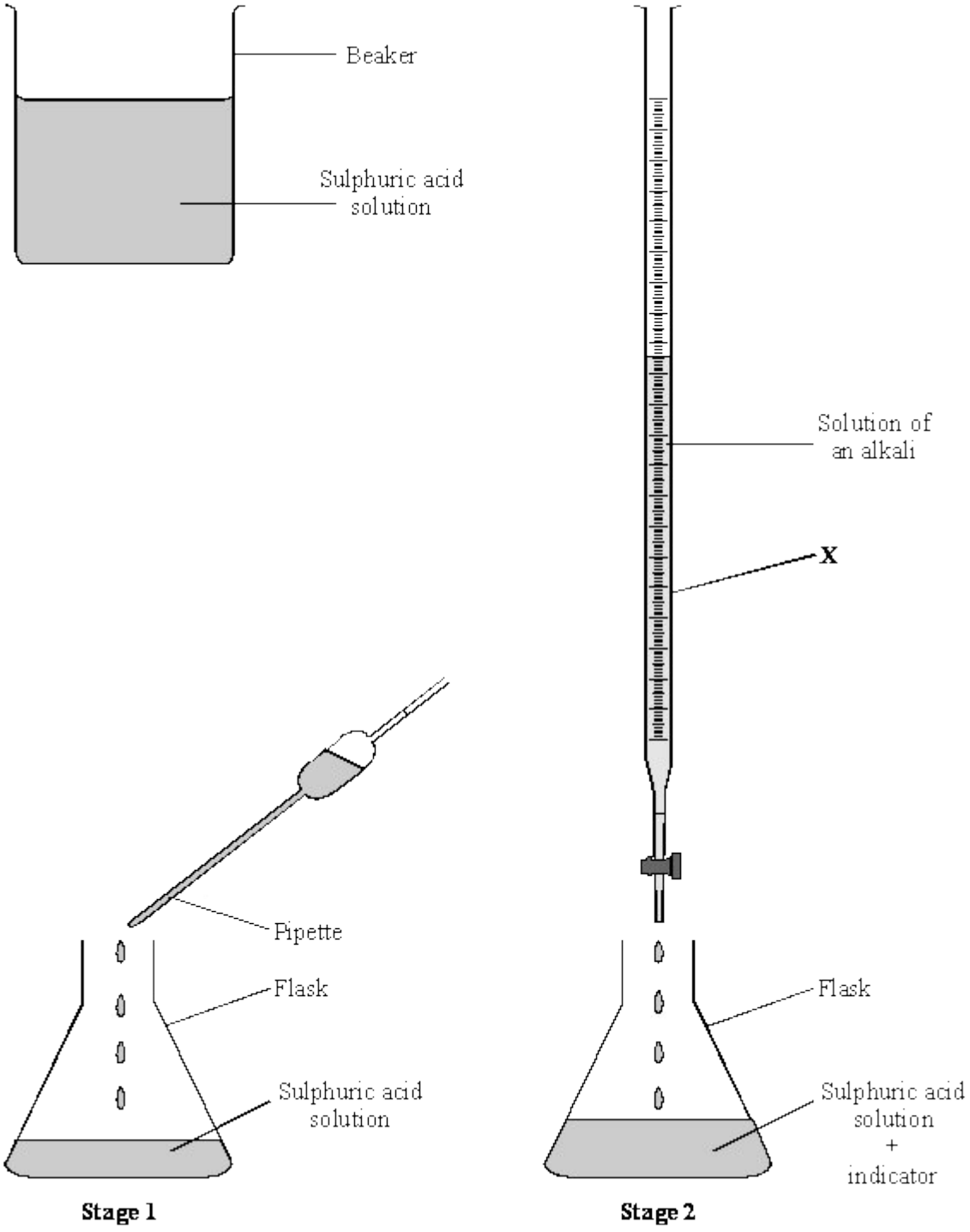
(2)

(Total 10 marks)

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Q24.

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



Stage 1 25.0 cm^3 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)

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(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?

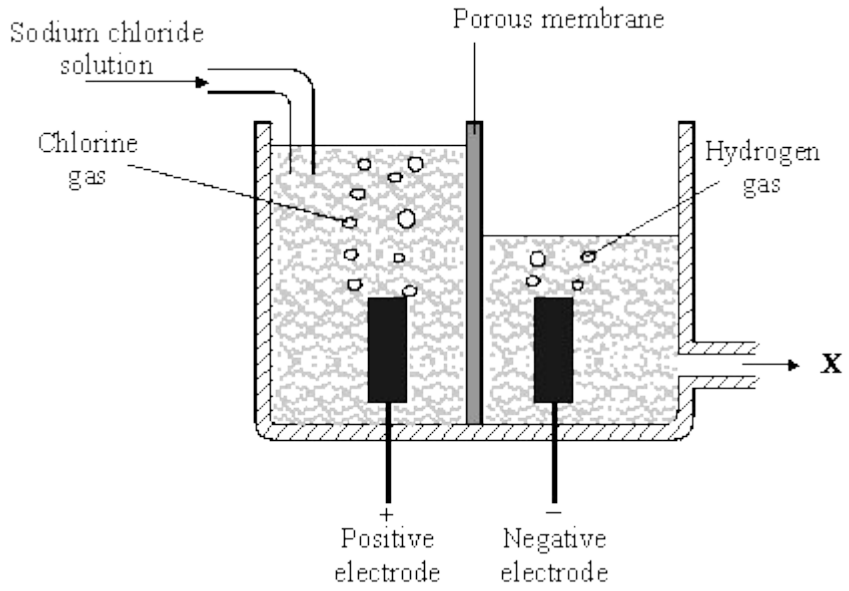
_____

(1)

(Total 6 marks)

Q25.

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?

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_____

(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.

_____

(3)

(Total 7 marks)

Q26.

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

$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

(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^3.

_____

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_____

_____

_____

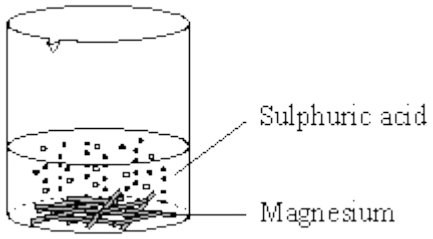
Concentration = _____ mol/dm^3

(3)

(Total 9 marks)

Q27.

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.

_____ + H_2SO_4 → _____ + _____

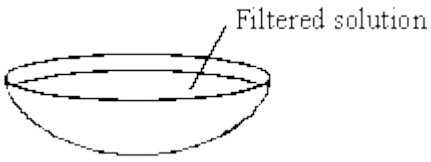
(3)

(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)

Q28.

Acids and bases are commonly found around the home.

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(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 _____

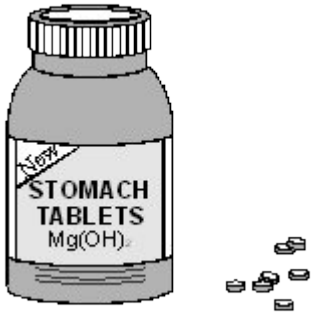
(2)

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

$NaHCO_3$ + H_2SO_4 → _____ + _____ + _____

(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.

$Mg(OH)_2$ + 2HCl → $MgCl_2$ + $2H_2O$

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

_____

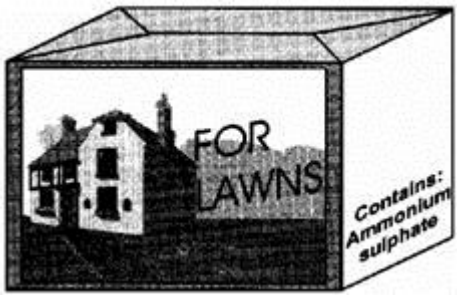
(2)

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

_____

(1)

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



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

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q29.

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 (H_2SO_4)	red
Sodium hydroxide (NaOH)	purple
Sodium chloride (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 _____

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(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?

_____

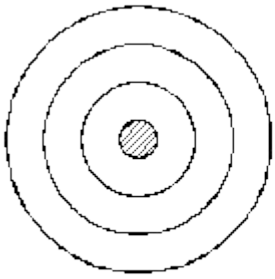
(1)

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

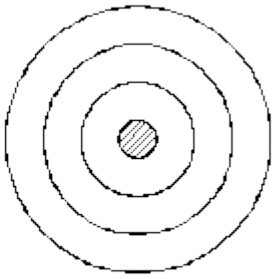
_____(aq) + _____(aq) → _____(aq) + _____(l)

(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?

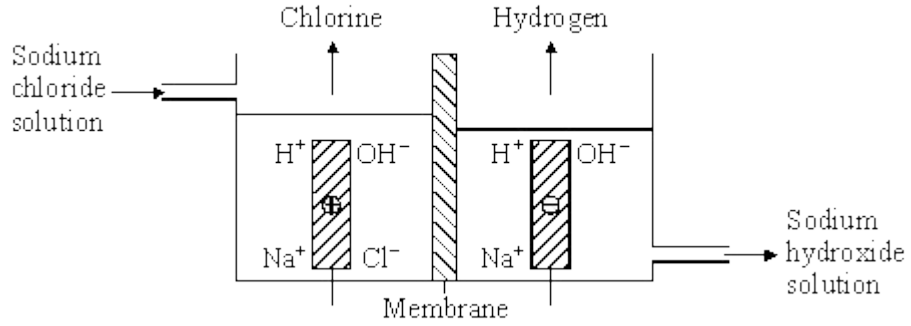
_____

_____

(1)

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

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Describe how each of these products are formed.

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)

Q30.

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

(a) Describe how this titration is carried out.

_____

_____

_____

_____

_____

(3)

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

Relative atomic masses: H 1; Cl 35.5

_____

Answer = _____ mol/dm^3

(2)

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

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

_____

Answer = _____ mol

(2)

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

_____

Answer = _____ mol/dm^3

(2)

(Total 9 marks)

Q31.

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



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

$CaCO_3(\ \ ) + 2HCl(aq) \rightarrow CaCl_2(\ \ ) + H_2O(\ \ ) + CO_2(\ \ )$

(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?

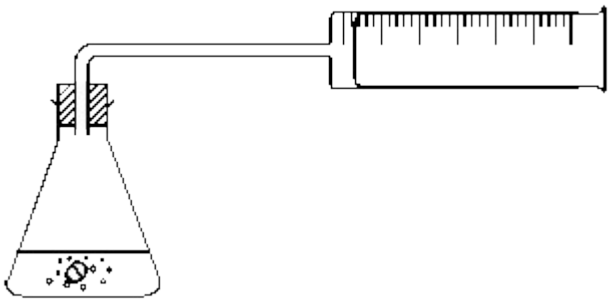
_____

_____

(1)

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

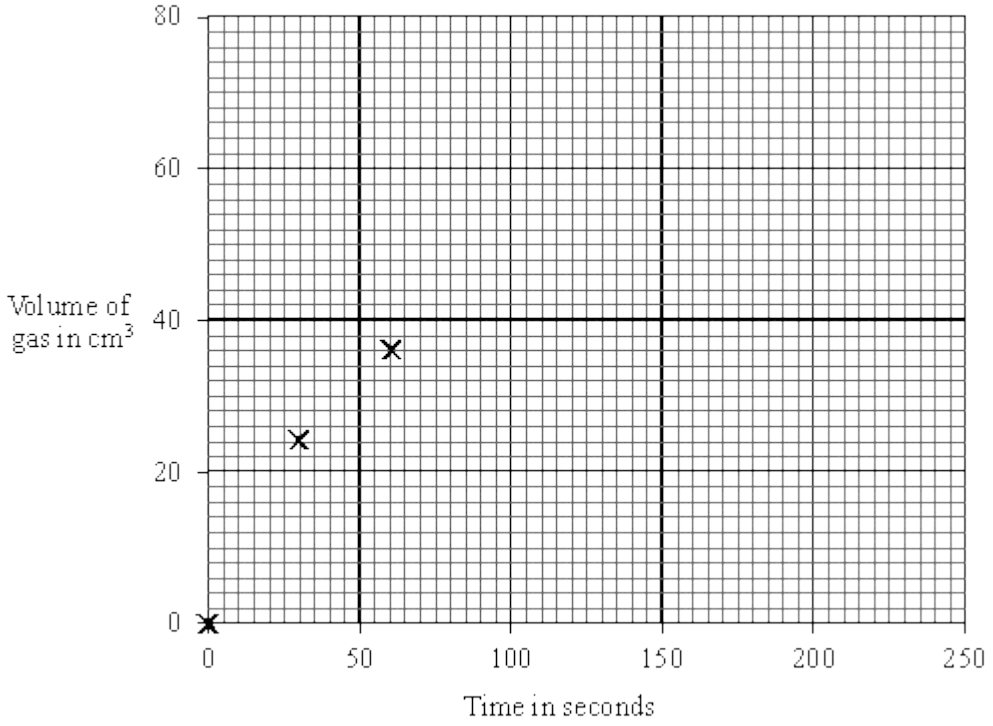
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The volume of carbon dioxide was recorded every 30 seconds until the reaction stopped.

Time in seconds	0	30	60	90	120	150	180	210	240
Volume of gas in cm^3	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^3 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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_____

_____

_____

_____

_____

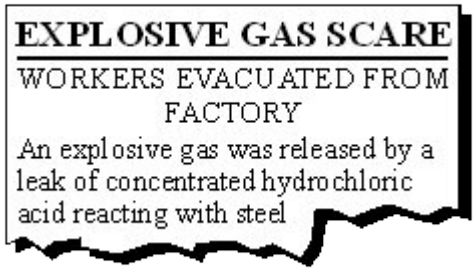
_____

(3)

(Total 10 marks)

Q32.

This article appeared in a newspaper.



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

$Fe(s) + 2HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$

(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.

_____

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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.

(aq) + (aq) → H_2O(l)

(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)

Q33.

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^3 of 0.40 mol/dm^3 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^3.

(a) What piece of apparatus would be used to measure 25.0 cm^3 of the potassium hydroxide solution?

_____

(1)

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

_____

(1)

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

_____

_____

Moles of potassium hydroxide = _____ mol

(2)

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

$KOH + HCl \rightarrow KCl + H_2O$

_____

_____

_____

Concentration of hydrochloric acid = _____ mol/dm^3

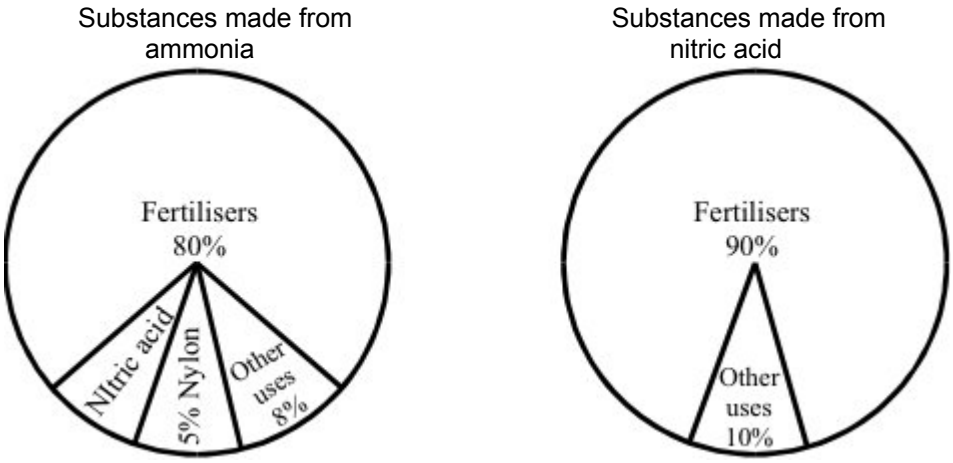
(2)

(Total 6 marks)

Q34.

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

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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.

_____

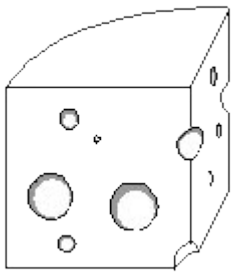
(1)

(Total 9 marks)

Q35.

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

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

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

_____ hydroxide

(1)

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

_____

(1)

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

_____

_____

(1)

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

_____

(1)

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

_____

(1)

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

_____

(1)

(Total 6 marks)

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