AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.4.2 REACTIONS OF ACIDS (PACK 4)

SCORE	PERCENTAGE
/159	%

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Q1.

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:

$NH_3 + HNO_3 \rightarrow NH_4NO_3$

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)

_____

_____

_____

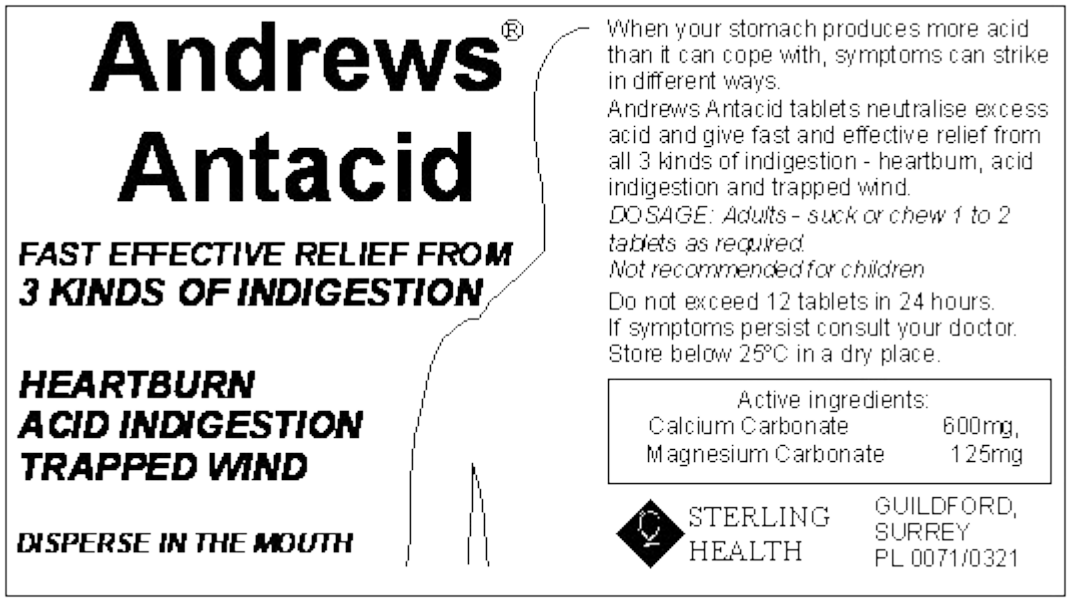
_____

(3)

(Total 4 marks)

Q2.

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



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

_____

(1)

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

_____

_____

_____

_____

(1)

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

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

40 cm^3 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.

$CaCO_{3(s)}$ + _____ $HCl_{(aq)}$ → $CaCl_{2(aq)}$ + $H_2O_{(l)}$ + $CO_{2(g)}$

(1)

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

_____

(1)

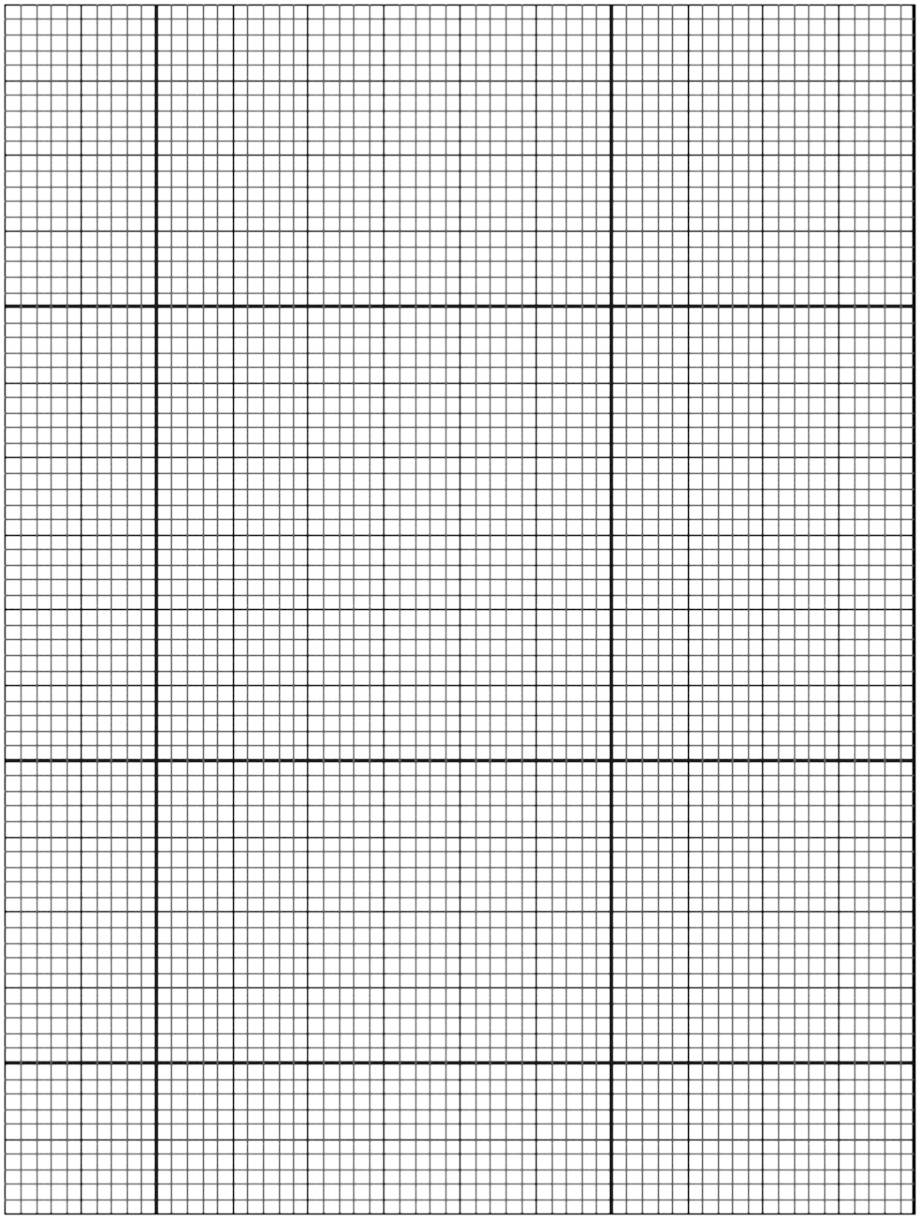
(iii) Why does the mass of the flask and contents decrease?

_____

(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”.

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(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".

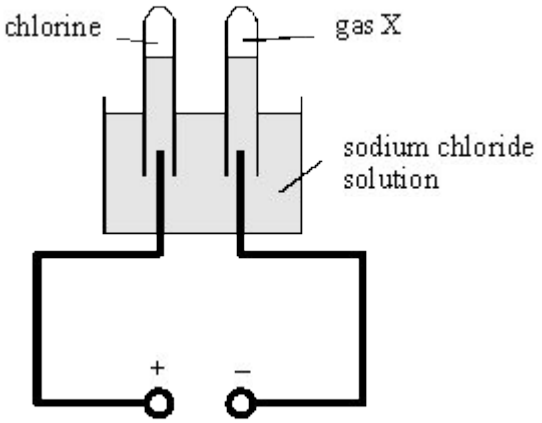
(2)

(Total 12 marks)

Q3.

(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.

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(i) Name gas X.

_____

(1)

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

_____ Cl^- → _____ e^- → Cl_2

(1)

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

Which ion makes the solution alkaline?

_____

(1)

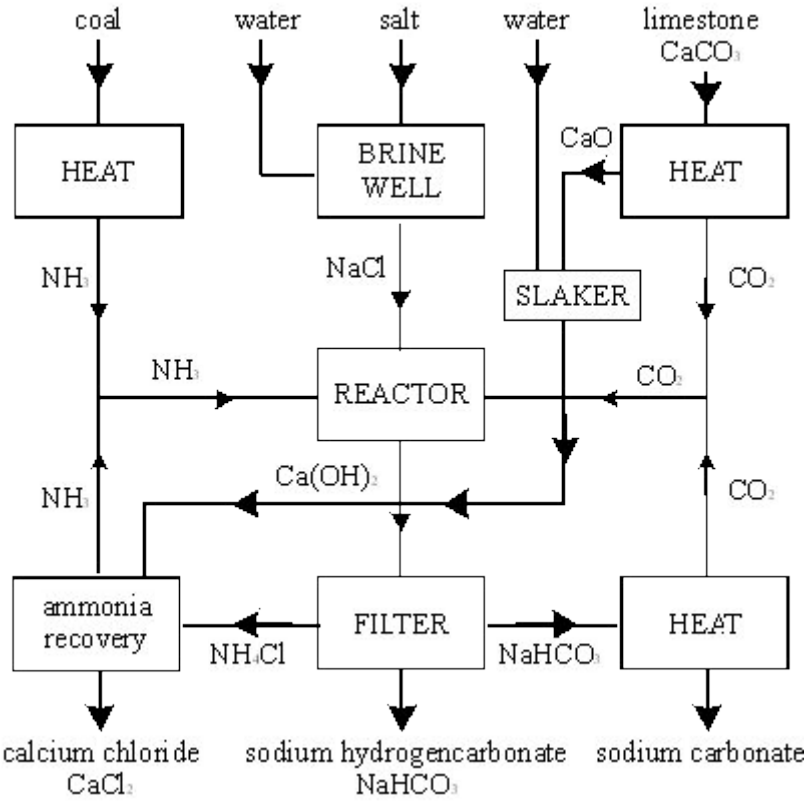
(iv) Name the useful substance that can be obtained from the solution in the cell.

_____

(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.

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(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.

_____

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_____

(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)

Q4.

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.

$KHCO_3$ KC1

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

_____

(1)

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

_____

(1)

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

Complete the two sentences below.

Atoms change into positive ions by _____ one or more

_____ .

Atoms change into negative ions by _____ one or

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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)

Q5.

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.

$$2Al_{(s)} + ____ NaOH_{(aq)} + _____ H_2O \rightarrow _____ NaAl(OH)_{4(aq)} + 3H_2$$

(2)

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

_____

(1)

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

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

_____

(1)

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(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)

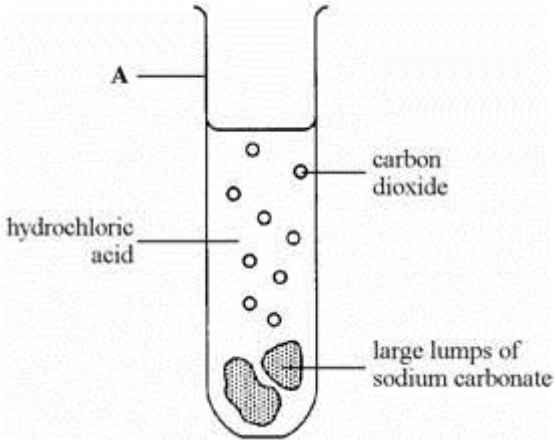
(Total 6 marks)

Q6.

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

sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide

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



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

_____

(1)

(ii) **$NaCO_3$** **NaCl** **Na_2CO_3** **Na_2Cl**

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

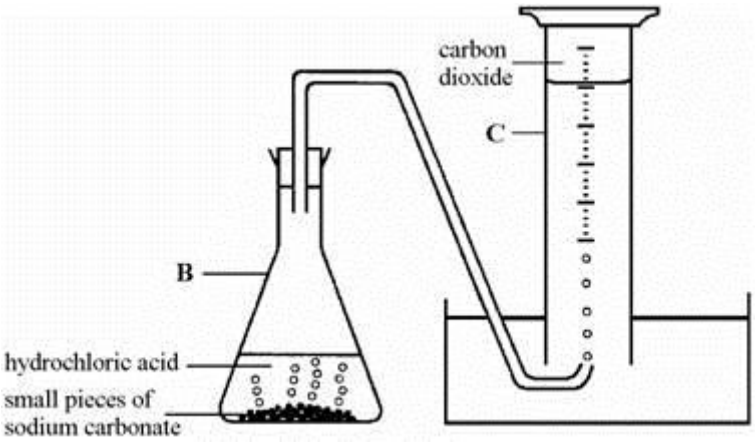
sodium carbonate, _____

sodium chloride. _____

(2)

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

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(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.

_____

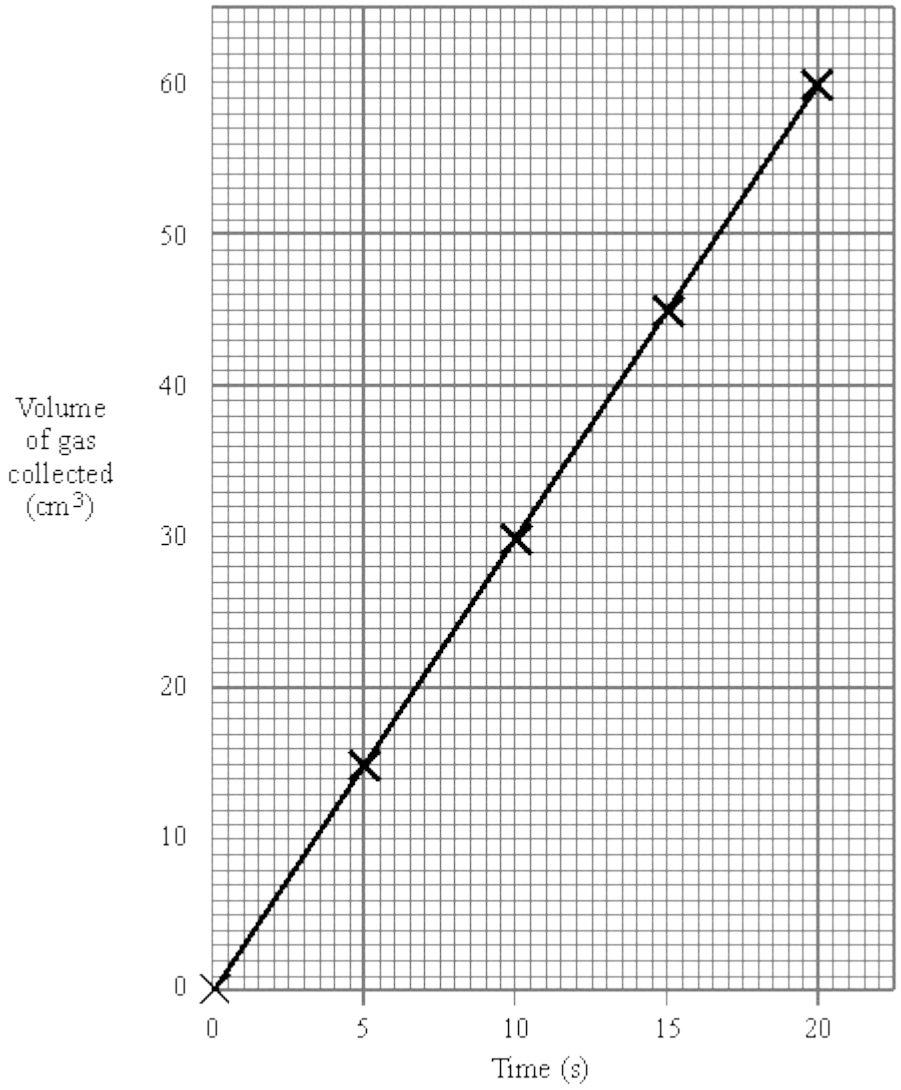
_____

_____

(2)

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

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(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)

Q7.

(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**

_____

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(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)

Q8.

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:

$Mg_{(s)} + 4HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + 2H_2O_{(1)} + 2NO_{2(g)}$

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.

_____

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_____

_____

(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)

Q9.

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

_____ acid

(1)

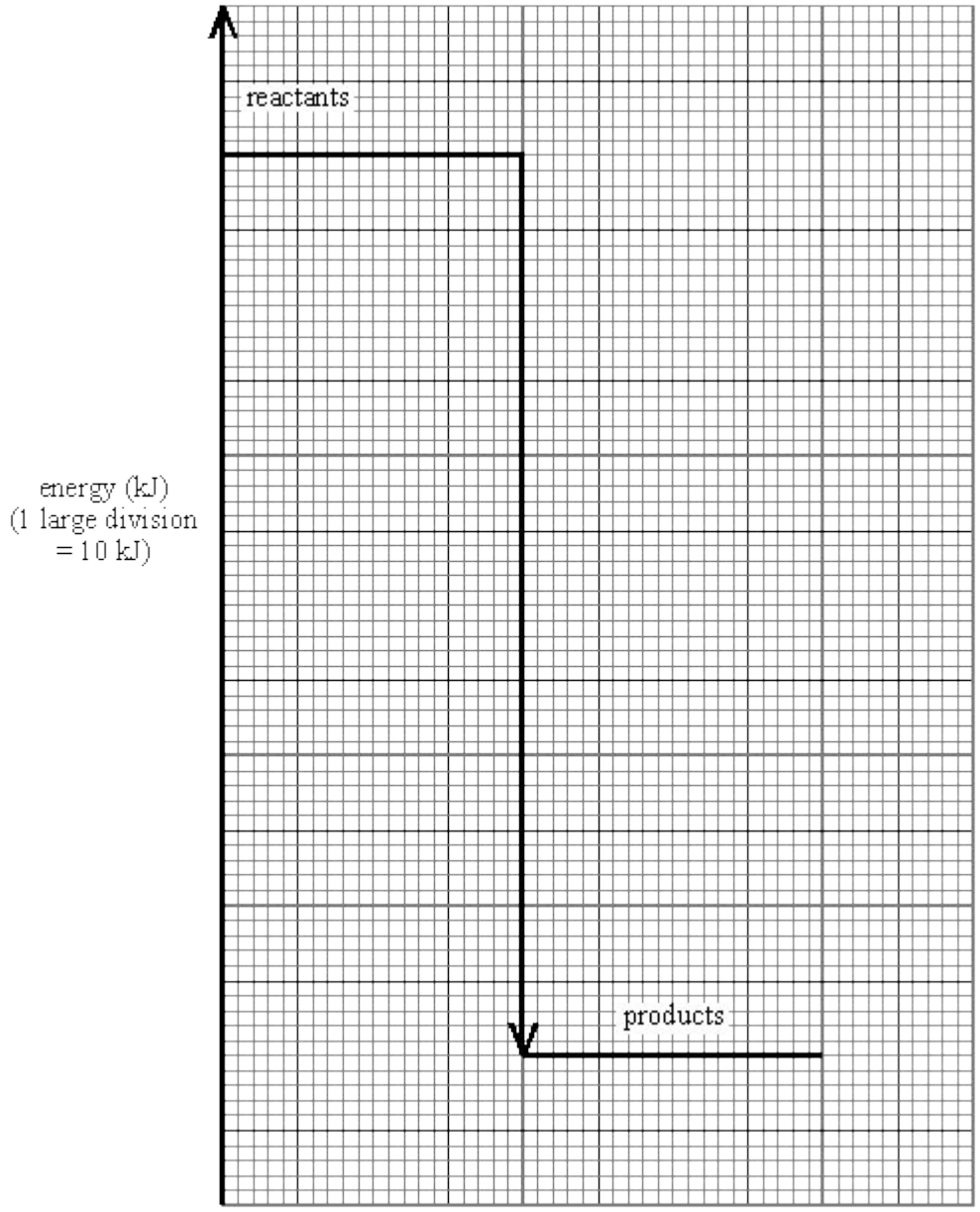
(ii) Use the table on the Data Sheet to help you to write the formula of sodium sulphate.

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.

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(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.

_____

_____

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_____

_____

(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)

Q10.

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.

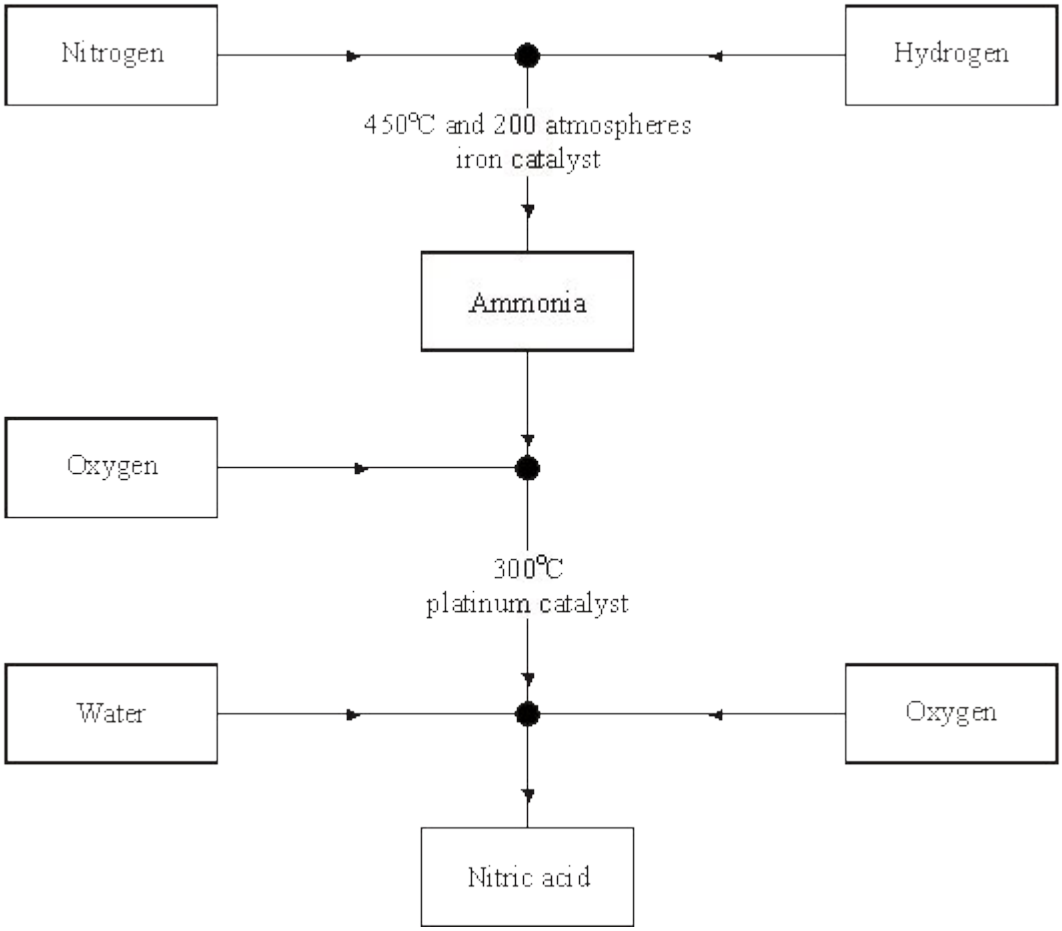
Acid	Alkali	Salt	Formula of salt
Hydrochloric acid	Sodium hydroxide	Sodium chloride	NaCl
Nitric acid	Sodium hydroxide		
Sulphuric acid	Potassium hydroxide		

(Total 4 marks)

Q11.

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

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(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)

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

_____

_____

_____

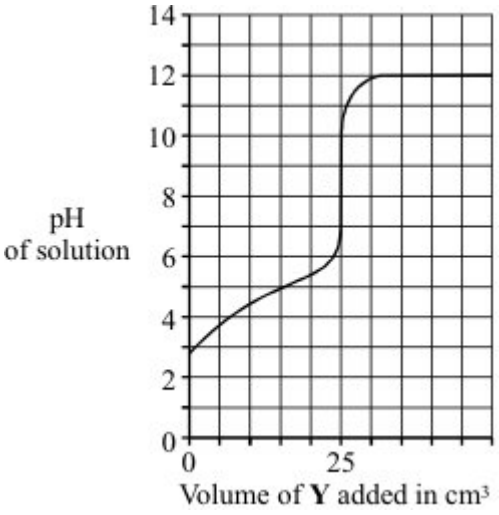
_____

(2)

(Total 7 marks)

Q12.

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^3

(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.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

(1)

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(ii) What is the formula of the salt?

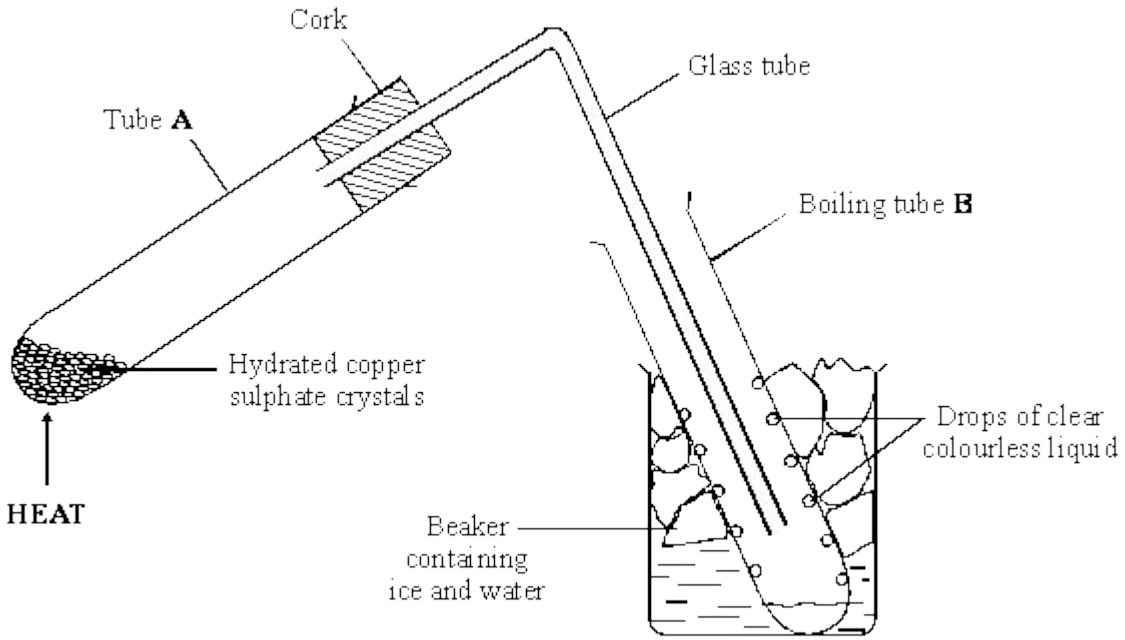
_____

(1)

(Total 5 marks)

Q13.

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?

_____

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_____

(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.

_____

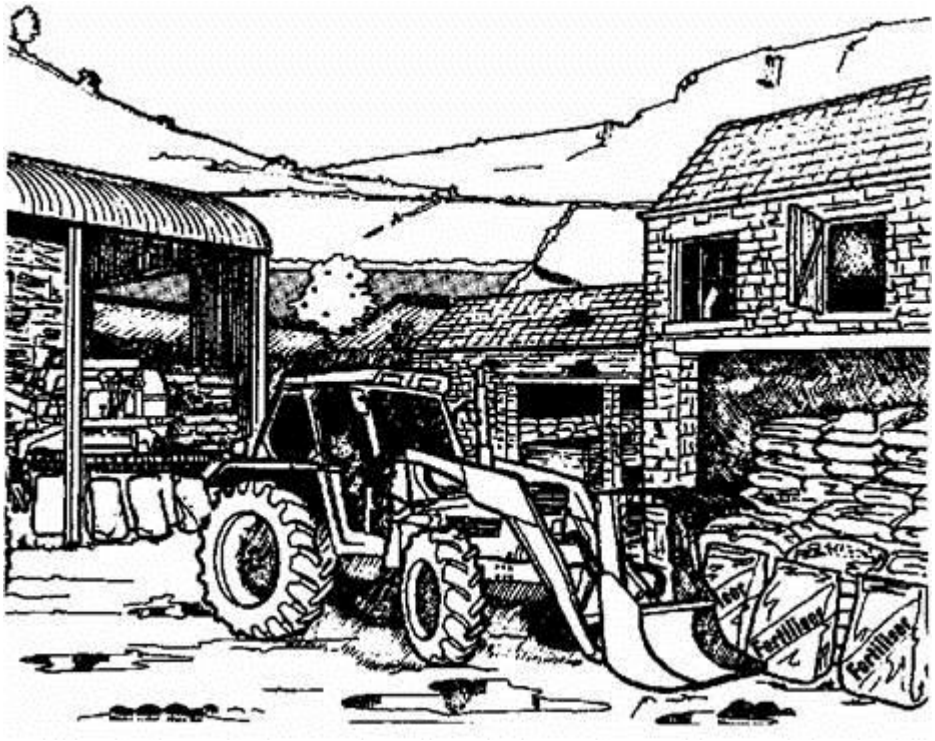
(1)

(Total 10 marks)

Q14.

Ammonium nitrate and ammonium sulphate are used as fertilisers.

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

_____

(1)

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

_____

(1)

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

_____

_____

(1)

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

_____

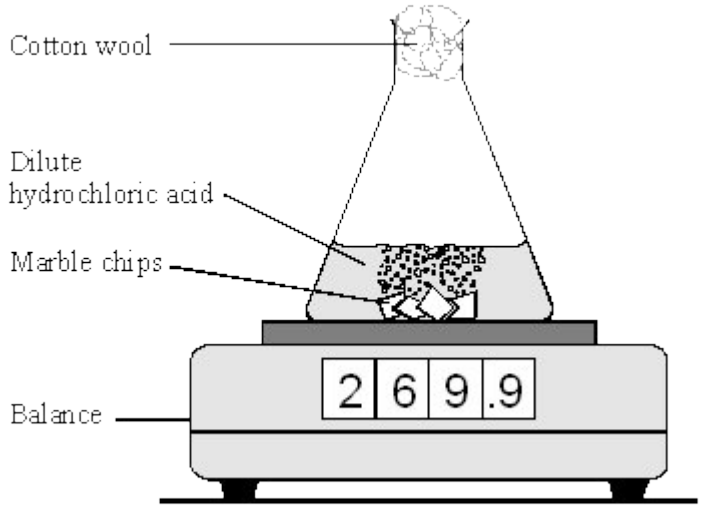
(1)

(Total 4 marks)

Q15.

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

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(a) Write a balanced equation for the reaction.

_____

_____

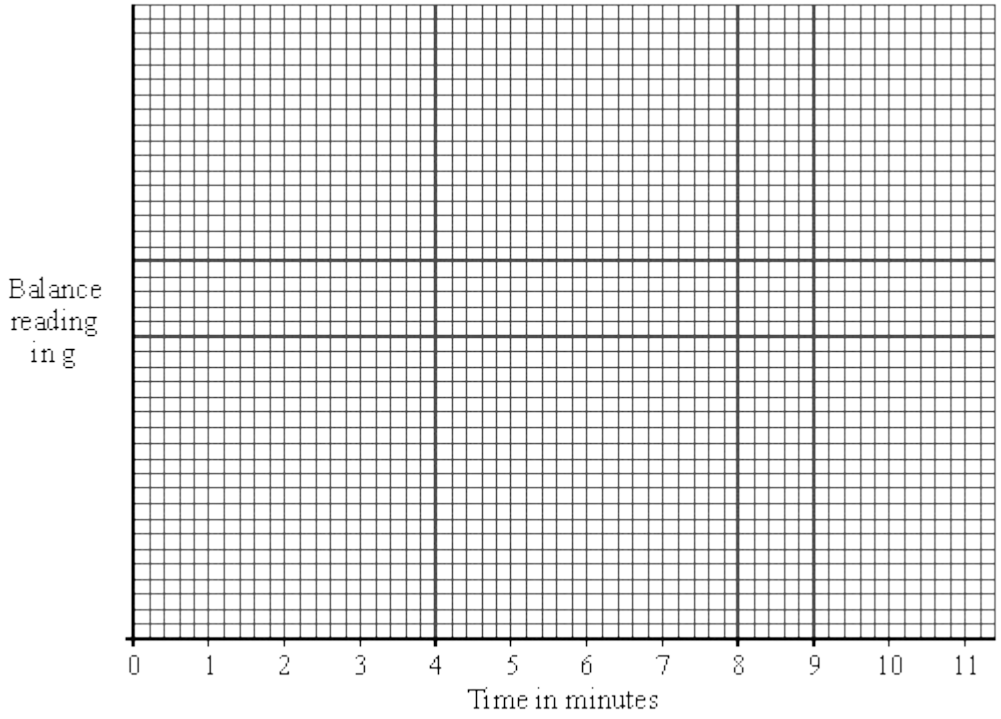
(2)

The following results were obtained from the experiment.

Time in minutes	**Reading on balance in g**
0.5	269.6
1.0	269.3
2.0	269.0
3.0	268.8
5.0	268.7
9.0	268.6

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

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(3)

(ii) Continue the graph you have drawn to show the expected reading after11 minutes.

(1)

(iii) On the axes above, sketch a graph of the result which would be obtained if in a similar experiment the same mass of powdered marble was used instead of marble chips.

(2)

(Total 8 marks)

Q16.

Potassium reacts violently with cold water.

It forms an alkaline solution of potassium hydroxide and hydrogen.

potassium + water → potassium hydroxide + 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)

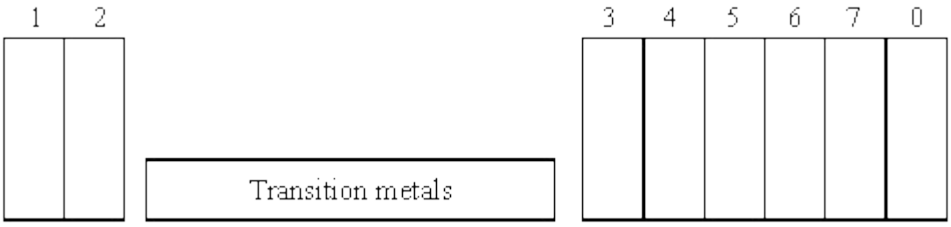
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(ii) What is the pH of the neutral solution?

_____

(1)

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



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

_____

(1)

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

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

_____

_____

(2)

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

_____

_____

(2)

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

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

_____

_____

(2)

(Total 10 marks)

Q17.

(a) Ammonium sulphate is made by the reaction:

$$2NH_3(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$$

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

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

(3)

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

_____

(1)

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

_____

(1)

(b) NH_3 is made by the reversible reaction:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

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

_____

_____

_____

(2)

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

_____

(1)

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

_____

_____

_____

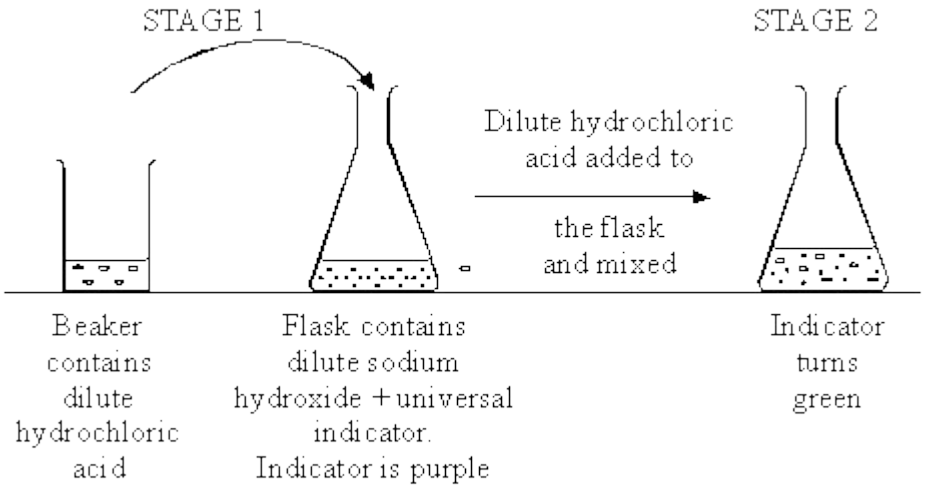
(2)

(Total 10 marks)

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Q18.

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.

_____

_____

_____

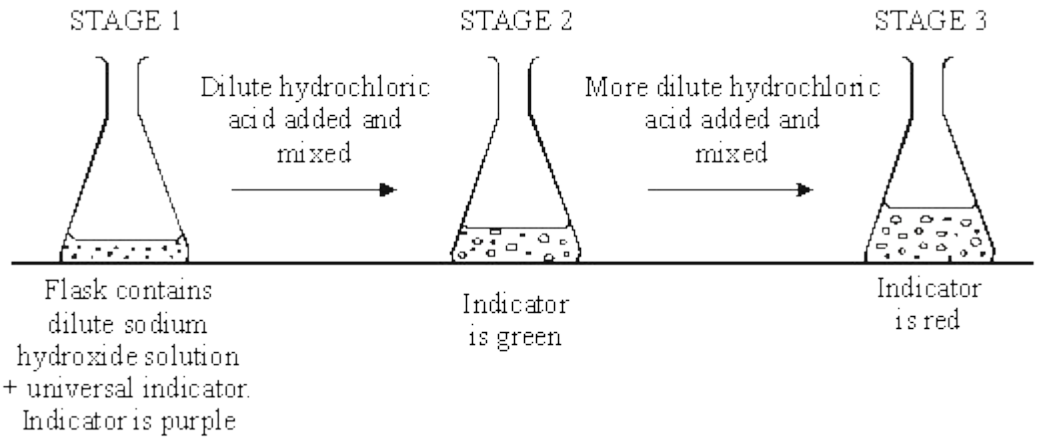
_____

(3)

(Total 4 marks)

Q19.

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?

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(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)

Q20.

Sodium carbonate reacts with acids.

(i) Complete the word equation.

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

(1)

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

_____

(1)

(Total 2 marks)

Q21.

Here is a word equation for a chemical reaction.

copper oxide + sulphuric acid ⟶ copper sulphate + water

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

_____

_____

_____

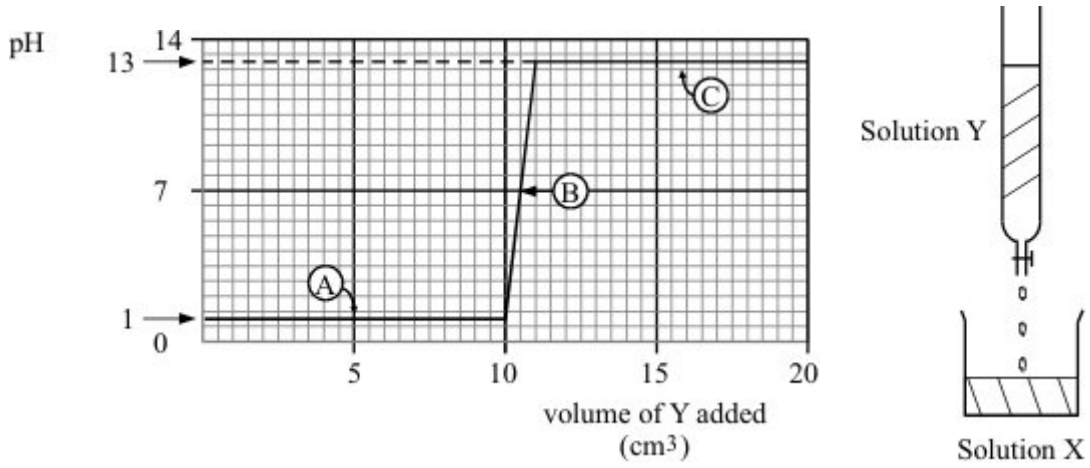
(Total 4 marks)

Q22.

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.

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(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)

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