PapaCambridge

5070 O'LEVELS CHEMISTRY

ACIDS, BASES & SALTS

THEORY QUESTIONS

Contents

Question 1.

B7 Malachite is an ore of copper. The formula of malachite is $CuCO_3.Cu(OH)_2$.

Malachite reacts as though it is a mixture of copper(II) carbonate and copper(II) hydroxide.

A small sample of malachite is added to excess dilute hydrochloric acid, HC*l*(aq). The carbon dioxide formed is collected and has a volume of 96 cm^3 at room temperature and pressure.

(a) What would you observe when malachite reacts with HC*l*(aq)?

.....

..... [2]

(b) Construct the equation for the reaction between malachite and HC*l*(aq).

..... [2]

(c) Calculate the mass of carbonate ion, CO_3^{2-}, in the sample of malachite.

mass of CO_3^{2-} = ... g [3]

s/13/qp21

Question 2.

(c) Carbon dioxide dissolves in water to form a weakly acidic solution.

$$CO_2(g) + H_2O(l) \rightleftharpoons HCO_3^-(aq) + H^+(aq)$$

(i) What is the meaning of the term *weak acid*?

.....

.....[1]

(ii) Describe how you could measure the pH of this solution other than by using a pH meter.

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.....[2]

(d) Sodium hydrogencarbonate, $NaHCO_3$, decomposes on heating to form a carbonate, water and a gas which turns limewater milky.
Construct an equation for this reaction.

[2]

w/13/qp22

Question 3.

(d) Ethanoic acid is a weak acid. It reacts with magnesium giving a gas and a magnesium salt.

(i) What is meant by the term *weak acid*?

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.....

.....

(ii) Name the gas formed.

.....

s/02/qp2

Question 4.

A6 A student adds aqueous sodium hydroxide from a burette into 25.0 cm^3 of dilute sulphuric acid. The student measures the pH value of the mixture during the addition of the sodium hydroxide.

(a) Describe how the pH value changes.

.....[1]

(b) Give an ionic equation to represent the neutralisation reaction between sodium hydroxide and sulphuric acid.

.....[1]

(c) Sulphuric acid is a strong acid.

(i) What is meant by the term *acid*?

.....

.....

(ii) What is the difference between a strong acid and a weak acid?

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.....

.....
[3]

(d) Dilute sulphuric acid reacts with magnesium to give hydrogen.
Give the ionic equation for this reaction.

.....[1]

s/03/qp2

Question 5.

A4 This question is about calcium compounds.

(a) Write the equation for the thermal decomposition of calcium carbonate. One of the products of this reaction is calcium oxide.

..... [1]

(b) When water is added to calcium oxide, calcium hydroxide is formed.

(i) Write the equation for the reaction between water and calcium oxide.

..... [1]

(ii) Solid calcium hydroxide reacts slowly with carbon dioxide. Name the calcium containing product of this reaction.

..... [1]

(c) State one large scale use of calcium hydroxide.

..... [1]

s/06/qp2

Question 6.

(d) Hydrazine, N_2H_4, has similar chemical properties to ammonia.

(i) Hydrazine reacts with hydrochloric acid. Suggest the formula of the product of this reaction.

..... [1]

s/10/qp22

Question 7.

(d) Hydrogen iodide is dissolved in water to make solution **X**.

(i) **X** is acidified with dilute nitric acid and then aqueous lead(II) nitrate is added. A yellow precipitate is formed.
Write an ionic equation, including state symbols, for this reaction.

[2]

s/10/qp22

Question 8.

A6 The table shows the concentration of different ions found in a sample of aqueous industrial waste.

ion	concentration in mol/dm^3
Ca^{2+}	0.125
H^+	2.30
K^+	0.234
NO_3^-	3.68
Fe^{2+}	0.450

Use the information in the table to answer the following questions.

(a) Write the formula of one salt that could be obtained from the sample.

.....[1]

(b) Is the sample of aqueous waste acidic, neutral or alkaline? Explain your answer.

.....

.....[1]

(c) Calculate the mass of dissolved iron(II) ions, Fe^{2+}, in 25 dm^3 of the aqueous waste.

mass of iron(II) ions = ... g [2]

(d) Excess aqueous sodium hydroxide is added, a small volume at a time, to a sample of the aqueous industrial waste.
Describe and explain what you would observe.

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.....[3]

B9 Sulfamic acid, SO_3NH_3, is a weak acid used to remove limescale from kettles.

(a) Explain the meaning of the term *weak acid*?

.....

.....[1]

(b) The pH of an aqueous solution of sulfamic acid can be determined using a pH meter. Describe another way of estimating the pH of a solution of sulfamic acid.

.....

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.....[2]

(c) A 0.105 g sample of sulfamic acid is dissolved in 25.0 cm^3 of water. The sulfamic acid solution requires 10.8 cm^3 of 0.100 mol dm^{-3} potassium hydroxide for complete neutralisation.

Calculate the number of moles of sulfamic acid that react with one mole of potassium hydroxide.

number of moles of sulfamic acid = ... [3]

(d) Aqueous sulfamic acid reacts with magnesium to form magnesium sulfamate, $Mg(SO_3NH_2)_2$.

(i) Write an equation for this reaction.

[1]

(ii) Limescale contains calcium carbonate. Describe, with the aid of an equation, how aqueous sulfamic acid reacts with calcium carbonate.

.....[2]

(e) Sulfamic acid reacts with sodium nitrite, $NaNO_2$, to form water, sodium hydrogensulfate, $NaHSO_4$, and a colourless gas.
Suggest the identity of the colourless gas.

.....[1]

[Total: 10]

Question 10.

B8 Propanoic acid, $C_2H_5CO_2H$, and hydrochloric acid, HCl, both act as acids when dissolved in water.

(a) State the formula of an ion found in both dilute propanoic acid and in dilute hydrochloric acid.

.....[1]

(b) Propanoic acid reacts with magnesium carbonate to form water, a colourless gas and a salt. In this reaction

(i) name the gas,

.....[1]

(ii) give the formula of the salt.

.....[1]

(d) Dilute hydrochloric acid reacts with aqueous silver nitrate to form a white precipitate. Write an ionic equation, with state symbols, for this reaction.

[2]

s/11/qp22

Question 11.

(b) Explain why phosphorus(III) oxide has the properties given below.

Property 1 Phosphorus(III) oxide is acidic

explanation .....

.....

w/03/qp2

B10 A toilet cleaner contains the acid salt, sodium dihydrogen phosphate, NaH_2PO_4.

(a) Explain why sodium dihydrogen phosphate is both an 'acid' and a 'salt'. [2]

(b) Sodium dihydrogen phosphate can be made by reacting sodium hydroxide with phosphoric acid, H_3PO_4.

(i) Write an equation for the formation of sodium dihydrogen phosphate.

(ii) Suggest the formula of **two** other salts formed from sodium hydroxide and phosphoric acid. [3]

(c) The table shows information about other acidic compounds.

name	pH of a 0.5 mol / dm^3 solution	
sodium dihydrogen phosphate	4.5	increasing acid strength ↓
ethanoic acid	3.8	
sulphuric acid	1.0	

(i) Explain why sulphuric acid behaves as a *strong acid* but ethanoic acid behaves as a *weak acid*.

(ii) Describe an experiment, other than measuring pH, that you could carry out to show that sulphuric acid is a strong acid but ethanoic acid is a weak acid.

State what measurements you would make and what results you would expect. [5]

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Question 13.

(b) A student carried out some experiments to compare the relative strengths of dilute ethanoic acid with dilute hydrochloric acid.

(i) Describe a test that can be used to distinguish between dilute ethanoic acid and dilute hydrochloric acid.

.....

..... [2]

(ii) Name a solid substance that will react with both acids. Describe what you will **see** during the reaction.

substance .....

observations .....

..... [2]

w/04/qp2

Question 14.

(d) Calcium hydroxide is added to neutralise the acidic solution formed after chlorine has been added. This solution contains hydrochloric acid.

(i) Write an equation for the reaction of calcium hydroxide with hydrochloric acid.

.....[1]

(ii) Write the ionic equation for this reaction.

.....[1]

w/06/qp2

Question 15.

(b) Phosphorus(V) oxide, P_2O_5, absorbs water from the air to form meta-phosphoric acid, HPO_3.

(i) Write an equation for this reaction.

[1]

(ii) On addition of more water, phosphoric acid is formed. Phosphoric acid has typical acidic properties. What would you observe when aqueous phosphoric acid is added to

aqueous sodium carbonate, ...

blue litmus paper? .....

[2]

w/08/qp2

Question 16.

A5 Cement is made by heating clay with crushed calcium carbonate. During this process, the calcium carbonate is first converted to calcium oxide.

$$CaCO_3 \rightarrow CaO + CO_2$$

(a) **(i)** What name is given to this type of chemical reaction?

.....[1]

(ii) Suggest why calcium oxide is used to neutralise acidic soils.

.....[1]

(b) Concrete is made from cement, sand and water. When set, concrete is slightly porous. When rain water soaks through concrete, some of the uncombined calcium oxide dissolves to form calcium hydroxide.

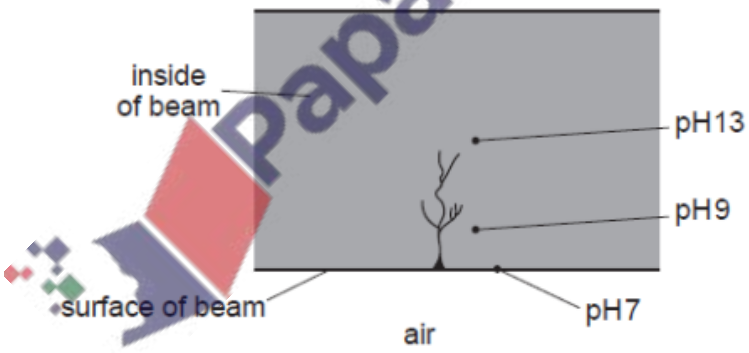
(i) Write an equation for this reaction.

[1]

(ii) The aqueous calcium hydroxide in wet concrete reacts with carbon dioxide in the air.

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

The diagram shows the pH at various points inside a cracked concrete beam.



Describe and explain the change in pH from the surface to the centre of the beam.

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.....[3]

Question 17.

A4 Methylamine, CH_3NH_2, is a base which has similar properties to ammonia. When methylamine dissolves in water, the following equilibrium is set up.

$$CH_3NH_2 + H_2O \rightleftharpoons CH_3NH_3^+ + OH^-$$

(a) Explain why methylamine behaves as a base in this reaction.

.....[1]

w/09/qp2

Question 18.

B9 Phosphine, PH_3, is a gas which has a smell of garlic. It is formed when white phosphorus is warmed with aqueous sodium hydroxide.

$$4P + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

(d) Phosphine reacts with hydrogen iodide to form the salt phosphonium iodide, PH_4I.

Phosphonium salts react in a similar way to ammonium salts when warmed with aqueous sodium hydroxide.

(i) Write an equation for the reaction of phosphonium iodide with aqueous sodium hydroxide.

.....[1]

(ii) What should you notice when sodium hydroxide is warmed with phosphonium iodide?

.....[1]

(e) Phosphine is formed when water reacts with calcium phosphide, Ca_3P_2.

Calcium phosphide is an ionic compound.

(i) Write the formula for the phosphide ion.

.....[1]

(ii) Predict one physical property of calcium phosphide.

.....[1]

w/10/qp21

Question 19.

(c) Aqueous bromine reacts with aqueous potassium iodide.

$$Br_2(aq) + 2KI(aq) \longrightarrow 2KBr(aq) + I_2(aq)$$

(i) Write an ionic equation for this reaction.

[1]

(d) Hydrochloric acid can be made by burning hydrogen in chlorine, then dissolving the product in water.
Give the formulae for the ions present in hydrochloric acid.

.....[1]

w/10/qp22

Question 20.

(b) Acid rain is a solution of dilute sulfuric acid.
The acidity in lakes can be neutralised by adding powdered calcium carbonate.

(i) Write an equation, including state symbols, for the reaction of calcium carbonate with sulfuric acid.

[2]

(ii) State one industrial use of sulfuric acid.

.....[1]

(iii) Sulfuric acid is a strong acid.
What do you understand by the term *strong acid*?

.....

.....[1]

w/10/qp22

Question 21.

B6 Seawater contains many dissolved ions. The table shows the concentration of some of these ions in a typical sample of seawater.

ion	formula	concentration / g / dm^3
chloride	Cl^-	19.00
sodium	Na^+	10.56
sulfate	SO_4^{2-}	2.65
magnesium	Mg^{2+}	1.26
calcium	Ca^{2+}	0.40
potassium	K^+	0.38
hydrogencarbonate	HCO_3^-	0.14

(a) Suggest the formula of one salt dissolved in seawater.

..... [1]

(d) Some countries purify seawater to make drinking water.
Name the process by which seawater is purified into drinking water.

..... [1]

(e) The pH of seawater is 7.9.

(i) State the formula of an ion, other than those in the table, which must be present in seawater to account for this pH. Explain your answer.

formula of ion .....

explanation .....

..... [2]

(ii) One way of measuring the pH of seawater is to use a pH meter.
Describe an alternative method of measuring the pH of seawater.

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.....

..... [2]

[Total: 10]

Question 22.

(f) Ethanoic acid is a weak acid whereas hydrochloric acid is a strong acid.
Describe the difference between a *weak acid* and a *strong acid*.
Include equations in your answer.

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..... [2]

s/12/qp21

Question 23.

A4 Many electricity generating power stations burn fossil fuels. The combustion of these fuels produces waste gases called flue gas.

The flue gas contains nitrogen oxides, sulfur dioxide and carbon dioxide.

Nitrogen oxides and sulfur dioxide contribute towards acid rain and must be removed from the flue gas before it is allowed to reach the atmosphere.

(a) One of the nitrogen oxides is nitrogen monoxide, NO.

(i) Nitrogen monoxide is formed by the direct reaction between oxygen and nitrogen.

Construct the equation for this reaction.

..... [1]

(ii) When cold nitrogen monoxide comes into contact with oxygen it forms nitrogen dioxide, NO_2.

Construct the equation for this reaction.

..... [1]

(b) Some power stations spray the flue gas with seawater. This removes about 99% of the nitrogen dioxide and sulfur dioxide.
The gases react with water to form aqueous acids. Nitrogen dioxide forms nitric acid and another acid with the formula, HNO_2.

Construct the equation for this reaction.

..... [1]

(c) In other power stations the flue gases are reacted with moist calcium carbonate. This removes about 90% of the nitrogen dioxide and sulfur dioxide from the flue gas.

(i) Sulfur dioxide reacts with calcium carbonate to form solid calcium sulfite, $CaSO_3$.
Suggest the name of the other product of this reaction.

..... [1]

(ii) Nitrogen dioxide reacts with calcium carbonate to form two salts.
Suggest the name and formula of one of these salts.

name .....

formula ..... [2]

(d) Suggest **two** advantages of treating flue gas with seawater rather than calcium carbonate.

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..... [2]

(e) Carbon dioxide is a greenhouse gas. This is because its covalent bonds can absorb infra-red radiation.

Draw a 'dot-and-cross' diagram to show the bonding in a molecule of carbon dioxide. Show only the outer shell electrons.

[1]

[Total: 9]

w/12/qp22

Question 24.

(b) Hydrogen fluoride is made by heating calcium fluoride, CaF_2, with concentrated sulfuric acid.
Give an equation for this reaction.

..... [2]

(c) Hydrogen chloride dissolves in water to form hydrochloric acid. Hydrogen fluoride dissolves in water to form hydrofluoric acid.
A 0.1 mol / dm^3 solution of hydrochloric acid is completely ionised.
A 0.1 mol / dm^3 solution of hydrofluoric acid is only 10% ionised.

Use this information to compare and explain

the strength of each acid, ...

.....

the pH of each of these solutions. .....

..... [2]

w/11/qp21

Question 25.

(ii) Nitric acid in the atmosphere can chemically erode buildings made from carbonate rocks.
Write an equation for the reaction of nitric acid, HNO_3, with calcium carbonate, $CaCO_3$.

[2]

w/11/qp22

Question 26.

(e) Describe how to obtain pure dry crystals of calcium chloride from an aqueous solution of calcium chloride.

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.....[2]

[Total: 10]

w/13/qp22

Question 27.

(b) Aqueous sodium hydroxide reacts with aqueous iron(II) sulfate, $FeSO_4$.
Construct the ionic equation, with state symbols, for this reaction.

.....[2]

(c) Iron(II) sulfate can be prepared by reacting excess iron powder with sulfuric acid.
Describe the essential practical details to prepare pure dry crystals of iron(II) sulfate.

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.....[2]

w/14/qp22

Question 28.

(e) Copper(II) chloride can be prepared by the reaction between copper(II) carbonate and hydrochloric acid.

(i) Construct the ionic equation for this reaction.

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..... [1]

(ii) Describe the essential practical details for the preparation of a crystalline sample of copper(II) chloride.

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..... [3]

s/12/qp22

Question 29.

(b) Describe the essential experimental details for preparing a pure sample of zinc nitrate crystals from zinc oxide.

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..... [4]

[Total: 9]

s/13/qp21

Question 30.

(d) Aqueous silver nitrate reacts with dilute hydrochloric acid to form a white precipitate.

Construct the ionic equation, including state symbols, for the formation of this white precipitate.

..... [2]

s/13/qp21

Question 31.

(d) Aluminium sulfate is a soluble salt.

Describe how a sample of aluminium sulfate crystals can be prepared from aluminium oxide.

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..... [4]

s/14/qp21

Question 32.

(d) Zinc sulfide reacts with hydrochloric acid to form hydrogen sulfide.
An aqueous solution of hydrogen sulfide behaves as a weak acid.

Describe what is meant by the term *weak acid*.

.....

.....[1]

(e) Zinc sulfate can be made by reacting zinc with dilute sulfuric acid.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

(i) Write an ionic equation for this reaction.

[1]

(ii) Describe how you would prepare crystals of pure, dry zinc sulfate using this reaction.

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.....[3]

(d) Aqueous copper(II) chloride reacts with aqueous sodium hydroxide to form a precipitate.

(i) Write the ionic equation, including state symbols, for the precipitation reaction.

(ii) What is the name and colour of the precipitate?

[4]

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Question 34.

B9 Fertilisers are soluble salts containing one or more of the essential elements required for plant growth.

(a) Ammonium chloride can be prepared by the reaction between aqueous ammonia and hydrochloric acid.

Write an **ionic** equation for this reaction. [1]

(b) State suitable reagents and outline the experimental procedure by which a pure sample of the fertiliser potassium chloride could be prepared in the laboratory. [4]

(c) Potassium sulphate can be prepared by the reaction between dilute sulphuric acid and potassium carbonate.

$$H_2SO_4 + K_2CO_3 \rightarrow K_2SO_4 + CO_2 + H_2O$$

Calculate the mass of potassium sulphate that can be prepared from 3.45 g of potassium carbonate. [3]

(d) Give electronic structures, including the charges, of the ions present in potassium chloride. [2]

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Question 35.

(c) Silver chloride is an insoluble salt.
Outline the preparation of pure, dry silver chloride, starting from solid silver nitrate. [4]

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Question 36.

B10 Fertilisers are used to promote plant growth and increase crop yield.
Three fertilisers are potassium chloride, potassium nitrate and ammonium phosphate.

(a) Potassium nitrate is a soluble salt that can be prepared by reaction between an acid and an alkali.

(i) Write an equation for the reaction of an acid with an alkali to prepare potassium chloride.

[1]

(ii) Describe the essential experimental details of this preparation of solid potassium chloride.

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..... [2]

(b) Ammonium phosphate is an ionic compound containing the phosphate ion, PO_4^{3-}.

(i) Write the formula for ammonium phosphate.

..... [1]

(ii) Calculate the percentage by mass of nitrogen in ammonium phosphate.

% by mass = ... [2]

s/10/qp22

Question 37.

(c) Potassium sulfate is a soluble salt.
Outline the preparation of a pure, dry sample of potassium sulfate, starting from dilute sulfuric acid.

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.....[3]

s/09/qp2

Question 38.

(c) Ammonium nitrate, NH_4NO_3, is a soluble salt.
The salt decomposes when heated gently to form steam and a colourless gas **X**.

(i) Ammonium nitrate can be prepared by the reaction between aqueous ammonia and dilute nitric acid.
Name the experimental technique used to prepare aqueous ammonium nitrate and briefly describe how solid ammonium nitrate is obtained from the aqueous solution.

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..... [2]

(ii) Predict the formula of gas **X**.

..... [1]

s/10/qp21

Question 39.

B9 **(a)** Brine is an impure solution of sodium chloride. The main impurity in brine is calcium chloride. It is removed by reacting the brine with sodium carbonate.

$$CaCl_2(aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaCl(aq)$$

(i) State the name for this type of reaction.

(ii) Construct an ionic equation for the reaction between calcium ions and carbonate ions to produce calcium carbonate.

(iii) Suggest how the calcium carbonate is removed from the mixture.

[3]

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w/01/qp2

Question 40.

A6 This question is about making salts.

(a) For each salt, suggest the name of the missing reagent and briefly describe how to obtain the solid product from the reaction mixture.

(i) Salt to be made: lithium chloride.

reagent 1: dilute hydrochloric acid

reagent 2: .....

I could obtain solid lithium chloride by: .....

.....

(ii) Salt to be made: barium sulphate.

reagent 1: aqueous potassium sulphate

reagent 2: .....

I could obtain solid barium sulphate by: .....

.....

(iii) Salt to be made: blue copper(II) sulphate crystals.

reagent 1: dilute sulphuric acid

reagent 2: .....

I could obtain blue copper(II) sulphate crystals by:

.....

..... [6]

(b) Ammonium sulphate can be made by reacting aqueous ammonia with dilute sulphuric acid.

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

Calculate the mass of ammonium sulphate that can be made from 51 g ammonia.

.....

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..... [3]

Question 41.

(c) When sulphuric acid is reacted with excess iron powder, iron(II) sulphate and hydrogen are produced.

Suggest how crystals of iron(II) sulphate could be prepared from this reaction mixture. [2]

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w/06/qp2

Question 42.

(b) Magnesium chloride is a soluble salt.
Describe how you can make pure dry crystals of magnesium chloride from magnesium carbonate.

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.....[3]

(c) The equation shows the reaction which occurs when magnesium carbonate is heated.

$$MgCO_3 \rightarrow MgO + CO_2$$

State the name given to this type of chemical reaction.

.....[1]

w/10/qp22

Question 43.

(c) Barium sulfate is an insoluble salt.
Describe how a pure dry sample of barium sulfate can be prepared from aqueous barium chloride in a laboratory.

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..... [4]

s/12/qp21

Question 44.

(e) Copper(II) chloride can be prepared by the reaction between copper(II) carbonate and hydrochloric acid.

(i) Construct the ionic equation for this reaction.

.....

..... [1]

(ii) Describe the essential practical details for the preparation of a crystalline sample of copper(II) chloride.

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..... [3]

w/12/qp22

Question 45.

B6 A student prepares some crystals of hydrated sodium sulfate by titrating aqueous sodium hydroxide with sulfuric acid.

(a) Describe how he can obtain pure dry crystals of sodium sulfate using this method.

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..... [4]

w/11/qp21

Question 46.

B9 Barium is a reactive metal in Group II of the Periodic Table.
Barium reacts with water in a similar way to sodium. The products of the reaction are aqueous barium hydroxide and a colourless gas.

(a) **(i)** Write an equation, including state symbols, for this reaction.

..... [3]

(ii) Aqueous barium hydroxide is neutralised by hydrochloric acid.
Write the simplest ionic equation for this reaction.

..... [1]

(b) Explain why barium metal conducts electricity.

..... [1]

(c) Barium oxide reacts with aluminium.

$$3BaO + 2Al \rightarrow 3Ba + Al_2O_3$$

Explain how this equation shows that aluminium is a reducing agent.

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..... [1]

(d) Barium sulfate is an insoluble compound.
Describe how a pure dry sample of barium sulfate is prepared from aqueous barium nitrate.

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..... [4]

[Total:10]

w/11/qp22

Question 47.

(c) Ammonium nitrate, NH_4NO_3, and ammonium sulfate, $(NH_4)_2SO_4$, are commonly used in fertilisers.

(i) Calculate the percentage of nitrogen by mass in ammonium nitrate.

[3]

(ii) Describe how crystals of ammonium sulfate can be prepared from aqueous ammonia.

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.....

.....[4]

(d) The formula of calcium phosphate is $Ca_3(PO_4)_2$.
Use this formula to deduce the charge on the phosphate ion.

.....[1]

[Total: 10]

Question 48.

B9 The compounds ammonium nitrate and ammonium sulfate are both fertilisers.

(a) Explain why farmers add these fertilisers to soils.

.....

.....[1]

(b) Ammonium sulfate can be prepared by adding sulfuric acid to aqueous ammonia.

Construct the equation for this reaction.

.....[1]

(c) Excess acidity in soils can be treated by adding calcium hydroxide.

(i) Give the formula of the ion present in calcium hydroxide which causes it to be alkaline.

.....[1]

(ii) Explain why adding calcium hydroxide causes loss of nitrogen from fertilisers such as ammonium nitrate, which have been previously added to the soil.

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.....[2]

(d) A student titrated $10.0\,cm^3$ of aqueous calcium hydroxide with hydrochloric acid.

$$Ca(OH)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$$

It required $4.00\,cm^3$ of $0.0100\,mol/dm^3$ hydrochloric acid to neutralise $10.0\,cm^3$ of aqueous calcium hydroxide.

Calculate the concentration of the calcium hydroxide.

..... $mol/\,dm^3$ [3]

Question 49.

(d) Sulfuric acid is one of the acids present in acid rain.

(i) Suggest how sulfuric acid is formed in the atmosphere.

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.....

.....[2]

(ii) State one effect of acid rain on human health.

.....[1]

[Total: 10]

w/14/qp22

Question 50.

A4 Many electricity generating power stations burn fossil fuels. The combustion of these fuels produces waste gases called flue gas.

The flue gas contains nitrogen oxides, sulfur dioxide and carbon dioxide.

Nitrogen oxides and sulfur dioxide contribute towards acid rain and must be removed from the flue gas before it is allowed to reach the atmosphere.

(a) One of the nitrogen oxides is nitrogen monoxide, NO.

(i) Nitrogen monoxide is formed by the direct reaction between oxygen and nitrogen.

Construct the equation for this reaction.

..... [1]

(ii) When cold nitrogen monoxide comes into contact with oxygen it forms nitrogen dioxide, NO_2.

Construct the equation for this reaction.

..... [1]

(b) Some power stations spray the flue gas with seawater. This removes about 99% of the nitrogen dioxide and sulfur dioxide.
The gases react with water to form aqueous acids. Nitrogen dioxide forms nitric acid and another acid with the formula, HNO_2.

Construct the equation for this reaction.

..... [1]

(c) In other power stations the flue gases are reacted with moist calcium carbonate. This removes about 90% of the nitrogen dioxide and sulfur dioxide from the flue gas.

(i) Sulfur dioxide reacts with calcium carbonate to form solid calcium sulfite, $CaSO_3$.
Suggest the name of the other product of this reaction.

..... [1]

(ii) Nitrogen dioxide reacts with calcium carbonate to form two salts.
Suggest the name and formula of one of these salts.

name .....

formula ..... [2]

(d) Suggest **two** advantages of treating flue gas with seawater rather than calcium carbonate.

.....

.....

.....

..... [2]

(e) Carbon dioxide is a greenhouse gas. This is because its covalent bonds can absorb infra-red radiation.

Draw a 'dot-and-cross' diagram to show the bonding in a molecule of carbon dioxide. Show only the outer shell electrons.

[1]

[Total: 9]

s/12/qp22

Question 51.

A2 Farmers use chemicals to improve crop yield.

Ammonium phosphate, $(NH_4)_3PO_4$, is used as a fertiliser and calcium hydroxide, $Ca(OH)_2$, is used to reduce the acidity of soils.

The relative formula mass of ammonium phosphate is 149.

(a) Calculate the percentage by mass of nitrogen in ammonium phosphate.

percentage = ... % [1]

(b) A farmer adds ammonium phosphate to a field.

He then adds calcium hydroxide to the field because the soil is very acidic.

(i) Calcium hydroxide neutralises the acid in the soil.

Give the ionic equation for this reaction.

.....[1]

(ii) The calcium hydroxide reduces the effectiveness of the ammonium phosphate fertiliser because it reduces the nitrogen content.

Explain why adding calcium hydroxide reduces the nitrogen content.

.....

.....

.....[2]

s/14/qp22

Question 52.

B7 Nitrogenous fertilisers are used to increase crop yield. Potassium nitrate, KNO_3, and ammonium sulphate, $(NH_4)_2SO_4$, are two nitrogenous fertilisers.

(a) Which fertiliser, potassium nitrate or ammonium sulphate contains the greater percentage mass of nitrogen? Explain your answer. [3]

(b) Explain some of the pollution problems that can be caused by the over-use of nitrogenous fertilisers. [3]

(c) Explain why adding calcium hydroxide to a soil can cause a loss of nitrogen. [2]

(d) A water supply is contaminated with ammonium sulphate.

Describe a chemical test for the sulphate ion in the water. [2]

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Question 53.

B11 Coal-burning power stations produce sulphur dioxide and oxides of nitrogen. These two gases cause acid rain.

(a) Nitric oxide, NO, is made in a power station when nitrogen and oxygen react together. Write the equation for this reaction. [1]

(b) Many coal burning power stations are now fitted with a flue gas desulphurisation plant which removes sulphur dioxide and nitrogen dioxide from the gaseous emissions.

In a flue gas desulphurisation plant, powdered calcium carbonate reacts with sulphur dioxide as shown.

$$SO_2(g) + CaCO_3(s) \longrightarrow CaSO_3(s) + CO_2(g)$$

(i) Suggest why the calcium carbonate is powdered. [1]

(ii) Calculate the mass of calcium carbonate needed to react with 8000 kg of sulphur dioxide. [3]

(iii) Nitrogen dioxide also reacts with calcium carbonate. Suggest the name of the solid product of this reaction. [1]

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s/03/qp2

Question 54.

(c) A farmer spreads a fertiliser containing ammonium nitrate onto his land. The farmer then spreads calcium hydroxide on his land to reduce its acidity.

Write an equation for the reaction between ammonium nitrate and calcium hydroxide. Use this equation to explain why the nitrogen content of the fertiliser will be lowered. [2]

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s/05/qp2

Question 55.

B8 River water contains many substances including minerals, dissolved oxygen, organic material, nitrates and phosphates.

(a) Give one source of phosphates in water. [1]

(b) Excess dissolved phosphates in river water cause *eutrophication*.
Describe the process of eutrophication. [3]

(c) **(i)** Describe a chemical test to show the presence of the nitrate ion. [2]

(ii) Suggest why it might be difficult to test for the presence of the nitrate ion in a sample of river water. [1]

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s/06/qp2

Question 56.

A6 Sulphur dioxide, SO_2, and nitrogen dioxide, NO_2, are both atmospheric pollutants formed during the combustion of coal at a power station.

(a) **(i)** State another source of sulphur dioxide as an atmospheric pollutant.

.....[1]

(ii) State another source of nitrogen dioxide as an atmospheric pollutant.

.....[1]

(b) Nitrogen dioxide and sulphur dioxide both cause acid rain. They are removed from the flue gases released from the power station by reaction with moist calcium carbonate in a process called flue gas desulphurisation.
Calcium carbonate reacts with sulphur dioxide to make a solid called calcium sulphite and a gas.

(i) What is the name of this gas?

.....[1]

(ii) Nitrogen dioxide reacts with calcium carbonate to make a solid. Suggest the name of this solid.

.....[1]

(iii) Describe one environmental effect of acid rain.

.....[1]

s/08/qp2

Question 57.

(c) A farmer adds excess calcium hydroxide to react with hydrogen ions in acidic soils. He then adds fertiliser to increase the nitrogen content of the soil.

(i) Write an ionic equation to show the neutralisation of hydrogen ions by solid calcium hydroxide.

[1]

(ii) Suggest why the farmer should use potassium nitrate rather than ammonium phosphate to increase the nitrogen content of the soil.

.....

..... [1]

s/10/qp22

Question 58.

(b) Eutrophication occurs in river water polluted by fertilisers.
Describe the principal processes involved in eutrophication.

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..... [3]

s/09/qp2

Question 59.

B10 Emissions from coal fired power stations contain sulphur dioxide, which causes acid rain.

Sulphur dioxide can be removed from the emissions by reaction with calcium carbonate.

(a) Name the raw material used as a source of calcium carbonate. [1]

(b) The sulphur dioxide reacts with the calcium carbonate to produce calcium sulphite, $CaSO_3$, and carbon dioxide.

(i) Write an equation for the reaction between calcium carbonate and sulphur dioxide.

(ii) A large coal-fired power station produces 960 tonnes of sulphur dioxide each year.

Calculate the mass of calcium carbonate needed to react with 960 tonnes of sulphur dioxide (1 tonne = 1×10^6 g).

[3]

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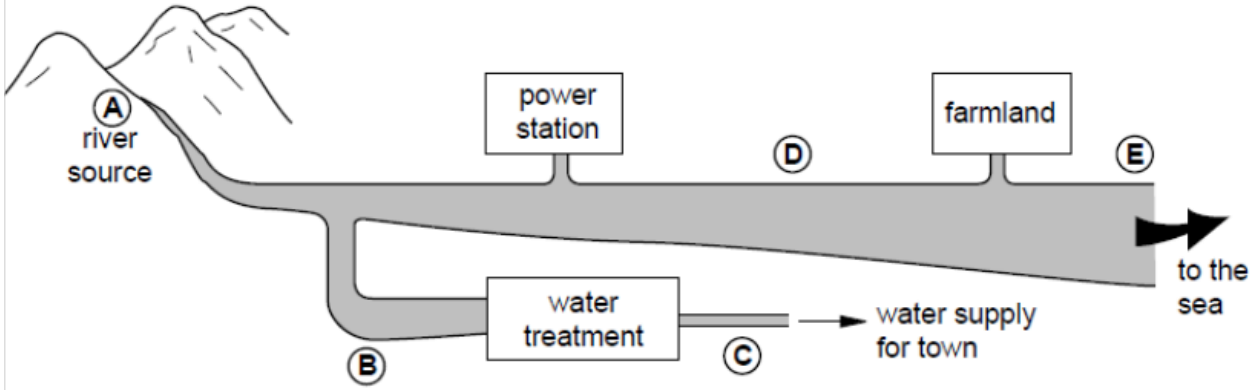
w/02/qp2

Question 60.

A1 The diagram shows where five water samples, **A** to **E**, were taken from a river.



The table shows information about the water samples.

sample	*temperature / °C*	*dissolved oxygen / ppm*
A	6	15
B	5	13
C	6	13
D	13	12
E	8	

(a) Describe how the temperature of the river water changes as it flows from the source of the river to the sea.

.....[1]

(b) Fertiliser enters the river as it flows past the farmland.

(i) Suggest the oxygen content of water sample **E**.

.....

(ii) Explain your reasoning.

.....

.....[3]

w/04/qp2

Question 61.

3 This table shows the soil pH ranges required by different crops for growth.

crop	pH range
peanut	5.0 – 6.5
millet	6.0 – 6.5
sunflower	6.0 – 7.5
paprika	7.0 – 8.5
mango	5.5 – 6.0

(a) A farmer plants peanut and millet crops. Only the peanut crop grows well. Predict the pH of the soil.

..... [1]

(b) Which other crop is most likely to grow well in the same soil?

..... [1]

(c) The farmer adds calcium hydroxide, $Ca(OH)_2$, and ammonium sulphate, $(NH_4)_2SO_4$, to the soil.

Explain the purpose of using each compound.

.....

.....

..... [3]

(d) A reaction occurs between calcium hydroxide and ammonium sulphate.

(i) Complete the equation for this reaction.

$Ca(OH)_2 + (NH_4)_2SO_4 \rightarrow$ ..... + ... + $2H_2O$

(ii) Explain why the farmer should not have added these two compounds to the soil at the same time.

..... [3]

[Total: 8 marks]

w/05/qp2

Question 62.

(d) Fertilisers are added to the soil to improve crop yields.
A farmer has the choice of two fertilisers, ammonium nitrate, NH_4NO_3, or diammonium hydrogen phosphate, $(NH_4)_2HPO_4$.

Show by calculation which of these fertilisers contains the greater percentage of nitrogen by mass.
You must show your working. [3]

(e) State one major problem caused when the nitrates from fertilisers leach from the soil into streams and rivers. [1]

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w/06/qp2

Question 63.

(e) Calcium carbonate is used in flue gas desulfurisation.
Describe this process and explain why it is important for the environment.

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.....

.....[2]

w/09/qp2

Question 64.

(b) Ammonia is used to make fertilisers.
Explain why farmers use fertilisers.

.....

..... [1]

(c) Many fertilisers are ammonium salts.
Explain why adding calcium hydroxide to the soil can cause the loss of nitrogen from the ammonium salts added as fertilisers.

.....

.....

..... [2]

(d) Fertilisers such as ammonium nitrate and ammonium phosphate are solids.
They can get into lakes and cause excessive growth of algae.

(i) Explain how these fertilisers get into lakes.

.....

..... [2]

(ii) What name is given to the enrichment of lakes with nitrates and phosphates which leads to the death of plant and animal life in the lakes?

..... [1]

[Total: 10]

w/11/qp22

Question 65.

B8 Many fertilisers contain phosphate ions and nitrate ions.

(a) Explain why farmers put fertilisers on the soil.

.....[1]

(b) Why should the chemicals in fertilisers be soluble in water?

.....[1]

(c) Ammonium nitrate, NH_4NO_3, and ammonium sulfate, $(NH_4)_2SO_4$, are commonly used in fertilisers.

(i) Calculate the percentage of nitrogen by mass in ammonium nitrate.

[3]

w/12/qp22

Question 66.

(d) Compounds containing hydroxide ions can be added to the soil to reduce its acidity.

(i) Explain why adding hydroxide ions to the soil can cause the loss of nitrogen from fertilisers containing ammonium salts.

.....[1]

(ii) Construct an ionic equation for this reaction.

[1]

w/12/qp22

Question 67.

A4 Water from natural sources, such as lakes and rivers, contains many dissolved substances.

(a) Name two dissolved substances that occur naturally in unpolluted water from lakes and rivers.

..... [1]

(b) Pollution in lakes and rivers can be caused by leaching of fertilisers from farmland. This can cause eutrophication.

(i) Name two ions present in fertilisers which cause eutrophication.

..... [2]

(ii) Describe the essential stages in eutrophication.

.....

.....

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.....

.....

..... [4]

[Total: 7]

w/12/qp21

Question 68.

(ii) Aqueous ammonia is added slowly to aqueous copper(II) sulfate until the ammonia is in excess.

Describe what you would observe as the ammonia is added.

.....

.....

.....[2]

(iii) Construct the ionic equation, with state symbols, for the reaction of aqueous copper(II) sulfate with aqueous sodium hydroxide.

.....[2]

w/14/qp21

Question 69.

A2 Small pieces of a silver coloured metal, **X**, were added to concentrated nitric acid. A brown gas, **Z**, and a colourless solution containing salt **Y** were formed.

Analysis of a 0.0914 mol sample of **Z** showed it contained 1.28 g of nitrogen and 2.93 g of oxygen.

The small sample of the colourless solution was diluted with water and then divided into two portions.

- To one portion, aqueous sodium hydroxide was added drop by drop until it was in excess. A white precipitate, **W**, was formed that redissolved in the excess sodium hydroxide.
- To the other portion, aqueous ammonia was added drop by drop until it was in excess. A white precipitate, **W**, was formed that redissolved in the excess ammonia.

(a) (i) Name the white precipitate, **W**.

..... [1]

(ii) Construct the ionic equation, with state symbols, for the formation of **W**.

..... [2]

(b) Name **X** and **Y**.

X is .....

Y is ..... [2]

(c) (i) Calculate the relative formula mass, M_r, for gas **Z**.

M_r = ... [2]

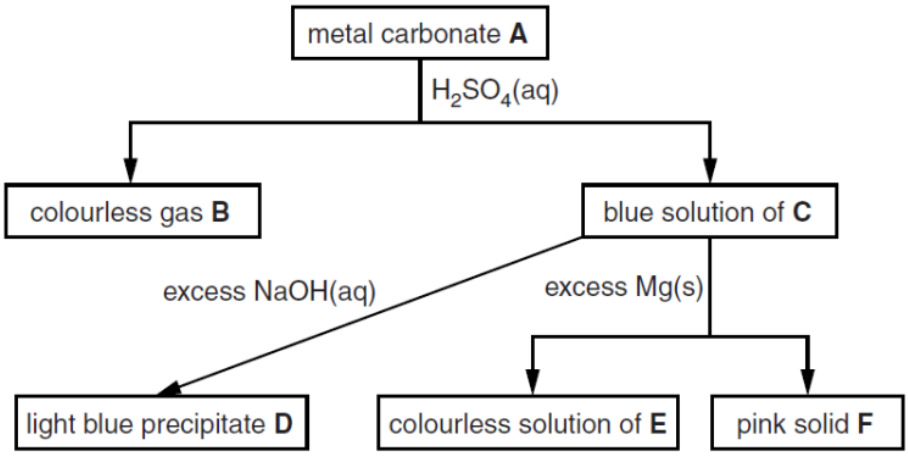
(ii) Determine the molecular formula for **Z**.

molecular formula is ..... [2]

[Total: 9]

Question 70.

A6 The flow chart shows some reactions of the compounds of a metal.



Identify, by name, each of the substances.

A .....

B .....

C .....

D .....

E .....

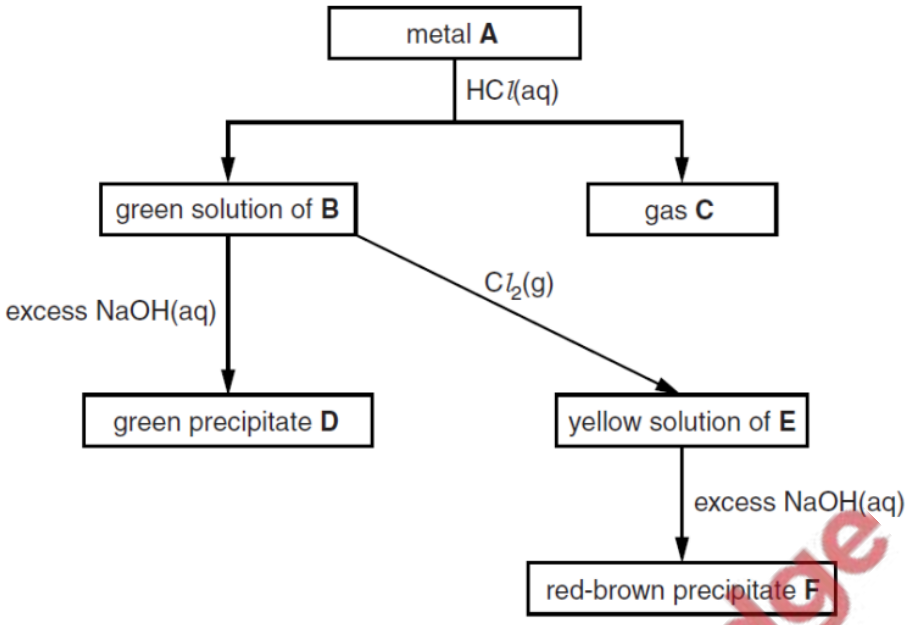
F .....

[Total: 6]

s/14/qp21

Question 71.

A6 The flow chart shows the reactions of metal **A** and some of its compounds.



Identify, by name, each of the substances.

A .....

B .....

C .....

D .....

E .....

F .....

[Total: 6]

s/14/qp22

Question 72.

(d) A scientist believes a water sample is contaminated by potassium nitrate.
Describe a chemical test to confirm the presence of aqueous nitrate ions.

.....

.....

.....

.....

..... [2]

[Total: 10]

Question 73.

(e) Describe how you would confirm the presence of dissolved nitrate ions in the sample.

.....

.....

.....

.....

.....

.....[4]

[Total: 11]

Question 74.

A2 Small pieces of copper were added to excess concentrated sulfuric acid and the mixture heated for 30 minutes. A colourless gas **Z** was formed. When **Z** was tested with filter paper dipped into acidified potassium dichromate(VI), there was a colour change from orange to green.

The reaction mixture was cooled and then diluted with water. A blue solution, **Y**, was formed. Aqueous sodium hydroxide was added drop by drop to the blue solution. Eventually a blue precipitate, **X**, was formed. On heating the blue precipitate turned black to form compound **V**. Analysis of **V** showed that it contained 79.9 % copper and 20.1 % oxygen by mass.

(a) Name gas **Z**.

.....[1]

(b) Name the blue solution **Y**.

.....[1]

(c) When aqueous sodium hydroxide was added to the cooled reaction mixture, it initially reacted with excess sulfuric acid.
Write the ionic equation for this reaction.

[1]

(d) **(i)** Name the blue precipitate **X**.

.....[1]

(ii) Write an ionic equation, including state symbols, to show the formation of this blue precipitate.

[2]

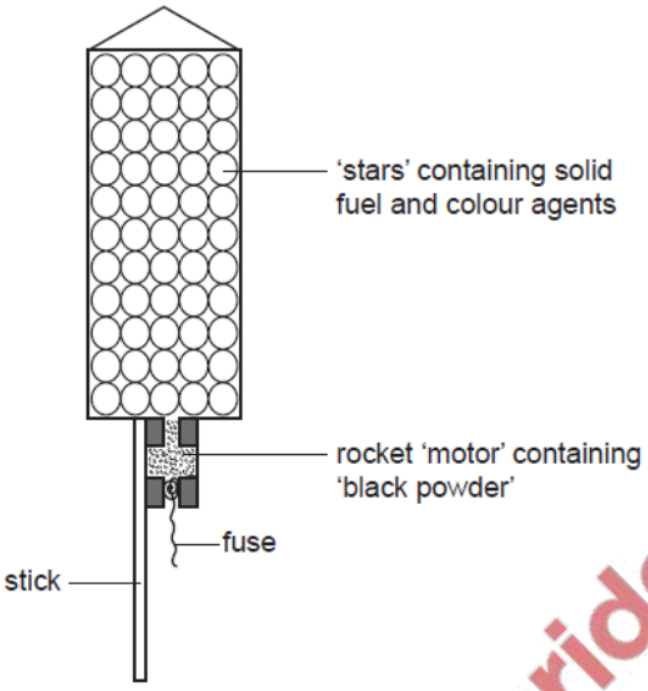
(e) Calculate the empirical formula of the black solid **V**.

empirical formula of **V** is ..... [2]

[Total: 8]

Question 75.

A6 The diagram shows the inside of a firework rocket.



(a) Black powder is a mixture of charcoal, potassium nitrate and sulphur.
When black powder is ignited, the potassium nitrate decomposes to form potassium nitrite, KNO_2, and oxygen.
Write the equation for the decomposition of potassium nitrate.

.....[1]

(d) Sodium sulphate is often used in fireworks to give yellow sparks.
Describe a test for sulphate ions and give the result.

test .....

result .....[2]

w/07/qp2

Question 76.

(d) Some types of glass contain lead ions, Pb^{2+}.
Dishwasher powders are highly alkaline.

(i) Which ion is responsible for alkalinity? [1]

(ii) When glasses containing lead ions are washed repeatedly in a dishwasher they go slightly white in colour.
Suggest a chemical explanation for why the glass goes white. Write an equation for the reaction which occurs. [2]

.....

.....

.....

.....

.....

.....

w/07/qp2

Question 77.

A2 Iron(II) sulfate crystals decompose when heated to give three gases **U**, **V** and **W** and an orange-brown solid **T**.

- Gas **U** was tested with filter paper soaked with acidified potassium dichromate(VI). The filter paper changed colour from orange to green.
- Analysis of gas **V** showed it contained 40.0% sulfur and 60.0% oxygen by mass.
- When gas **W** was condensed it formed a colourless liquid that turned anhydrous copper(II) sulfate from white to blue.

- Solid **T** was dissolved in dilute nitric acid. Aqueous ammonia was added drop by drop and a red-brown precipitate was obtained.

(a) (i) What is the formula for gas **U**?

..... [1]

(ii) Calculate the empirical formula of gas **V**.

empirical formula of **V** is ..... [2]

(iii) Name gas **W**.

..... [1]

(iv) Give the name or the formula of the metal ion present in solid **T**.

..... [1]

(b) Iron(II) sulfate dissolves in water to give a green solution **X**. Aqueous sodium hydroxide was added drop by drop to solution **X**. A green precipitate, **Y**, was formed.

(i) Name precipitate **Y**.

..... [1]

(ii) Construct the ionic equation, with state symbols, to show the formation of the precipitate, **Y**.

..... [2]

[Total: 8]

s/12/qp21

Question 78.

A2 Small pieces of a silver coloured metal, **X**, were added to concentrated nitric acid. A brown gas, **Z**, and a colourless solution containing salt **Y** were formed.

Analysis of a 0.0914 mol sample of **Z** showed it contained 1.28 g of nitrogen and 2.93 g of oxygen.

The small sample of the colourless solution was diluted with water and then divided into two portions.

- To one portion, aqueous sodium hydroxide was added drop by drop until it was in excess. A white precipitate, **W**, was formed that redissolved in the excess sodium hydroxide.
- To the other portion, aqueous ammonia was added drop by drop until it was in excess. A white precipitate, **W**, was formed that redissolved in the excess ammonia.

(a) (i) Name the white precipitate, **W**.

..... [1]

(ii) Construct the ionic equation, with state symbols, for the formation of **W**.

..... [2]

(b) Name **X** and **Y**.

X is .....

Y is ..... [2]

(c) (i) Calculate the relative formula mass, M_r, for gas **Z**.

M_r = ... [2]

(ii) Determine the molecular formula for **Z**.

molecular formula is ..... [2]

[Total: 9]

w/12/qp22

Question 79.

(c) When hydrated sodium sulfate crystals are heated gently, water is given off.

Describe a chemical test for water.

test .....

observation ..... [2]

w/11/qp21

Question 80.

(ii) Nitric acid contains nitrate ions.
Describe a test for nitrate ions.
Give the result of a positive test.

.....

.....

..... [3]

w/12/qp21

MOLES AND GRAPH

Question 81.

A5 A student titrates 20.0 cm^3 of a metal hydroxide, $M(OH)_2$, of concentration 0.060 mol/dm^3 with a strong acid of concentration 0.050 mol/dm^3.
It requires 24.0 cm^3 of acid to neutralise the metal hydroxide.

(a) (i) Calculate the number of moles of acid in 24.0 cm^3 of the acid.

..... moles [1]

(ii) Calculate the number of moles of OH^- ions in 20.0 cm^3 of the metal hydroxide.

..... moles [1]

(iii) Deduce whether the acid used is more likely to be hydrochloric acid or sulfuric acid.
Explain your answer.

.....

.....[1]

w/14/qp21

Question 82.

(c) Sulfuric acid is used to make superphosphate fertilisers. A mixture of the fertiliser and calcium sulfate is formed. This mixture is used by farmers.

$$Ca_3(PO_4)_2 + 2H_2SO_4 \rightarrow \underset{\text{calcium superphosphate}}{Ca(H_2PO_4)_2} + 2CaSO_4$$

(i) Calculate the percentage by mass of calcium sulfate in the mixture of calcium superphosphate and calcium sulfate.
(The relative formula mass of calcium superphosphate is 234.)

..... % [2]

(ii) Suggest one problem involved in either the transport of this mixture or its use as a fertiliser.

.....

.....[1]

[Total: 10]

w/14/qp21

Question 83.

(b) Magnesium chloride, $MgCl_2$, is present in seawater at a concentration of $1.26\,g/dm^3$.

(i) Write the formulae for the ions present in magnesium chloride.

.....[1]

(ii) Calculate the concentration of chloride ions, in mol/dm^3, arising from the magnesium chloride in seawater.

concentration = ... mol/dm^3 [1]

(iii) Aqueous silver nitrate is added to a small sample of seawater.
Describe what you would observe.

.....[1]

(c) The concentration of sulfate ions in seawater is $1.24\,g/dm^3$.
Excess aqueous barium chloride is added to a $50.0\,cm^3$ sample of seawater.

Calculate the mass of barium sulfate precipitated in this reaction.

$$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$$

mass = ... g [3]

w/14/qp22

Question 84.

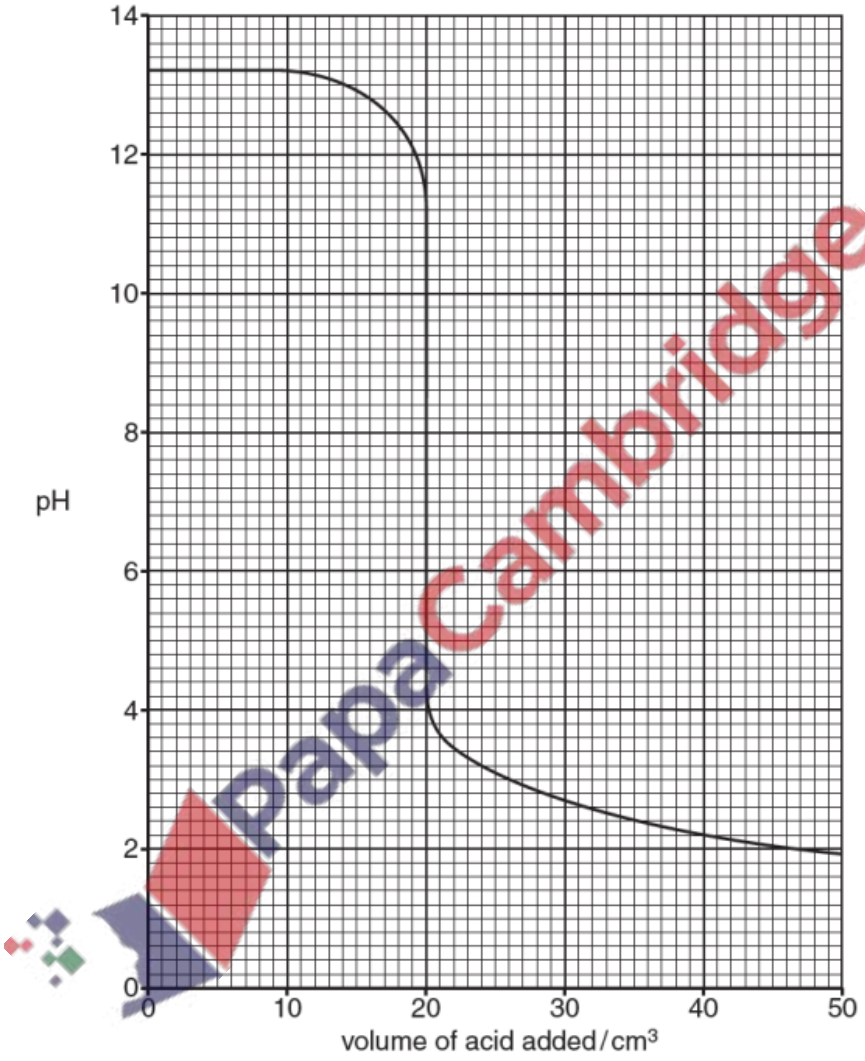
A4 Sulfuric acid reacts with the alkali sodium hydroxide.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

(a) Write the ionic equation for this reaction.

.....[1]

(b) The graph below shows how the pH changes when aqueous sulfuric acid is added slowly to 45.0 cm^3 of 0.150 mol/dm^3 sodium hydroxide until the acid is in excess.



(i) What volume of acid has been added when the pH is 7?

.....[1]

(ii) Use your answer to part (i) to calculate the concentration, in mol/dm^3, of the sulfuric acid.

concentration = ... mol/dm^3 [3]

(c) The experiment was repeated using ethanoic acid of the same concentration as the sulfuric acid. The same volume and concentration of aqueous sodium hydroxide was used.

(i) The volume of ethanoic acid required to neutralise the aqueous sodium hydroxide was twice as great compared with the volume of sulfuric acid.

Explain why.

.....

.....[1]

(ii) Suggest the value of the pH after excess ethanoic acid has been added.

.....[1]

(d) Sulfuric acid is one of the acids present in acid rain.

(i) Suggest how sulfuric acid is formed in the atmosphere.

.....

.....

.....[2]

(ii) State one effect of acid rain on human health.

.....[1]

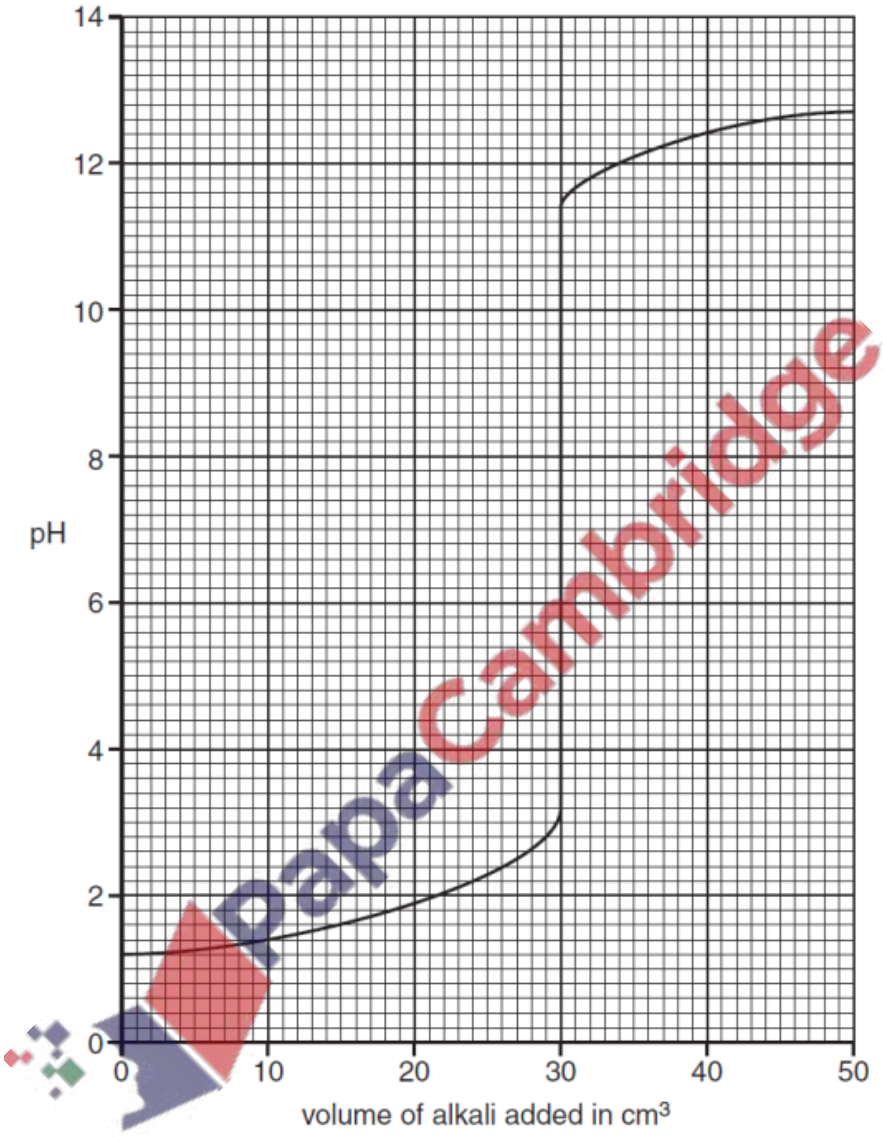
[Total: 10]

w/14/qp22

Question 85.

A5 Aqueous potassium hydroxide, KOH, is added slowly from a burette into a flask containing 25.0 cm^3 of 0.0500 mol/dm^3 dilute sulfuric acid, H_2SO_4. At the same time the pH of the contents of the flask is measured until all of the aqueous potassium hydroxide has been added.

The graph shows how the pH changes with the addition of the aqueous potassium hydroxide.



(a) What is the pH of 0.0500 mol/dm^3 sulfuric acid?

..... [1]

(b) Construct the equation for the reaction between sulfuric acid and potassium hydroxide.

..... [1]

(c) **(i)** What volume of aqueous potassium hydroxide has been added when the mixture has a pH of 7?

volume = ... cm^3 [1]

(ii) Calculate the concentration, in mol/dm^3, of the aqueous potassium hydroxide.

concentration = ... mol/dm^3 [3]

(d) The experiment is repeated with 25.0 cm^3 of 0.0500 mol/dm^3 ethanoic acid, CH_3COOH, instead of 25.0 cm^3 of 0.0500 mol/dm^3 sulfuric acid.

Describe and explain any differences in the graph which would be obtained.

.....

.....

.....

..... [2]

[Total: 8]

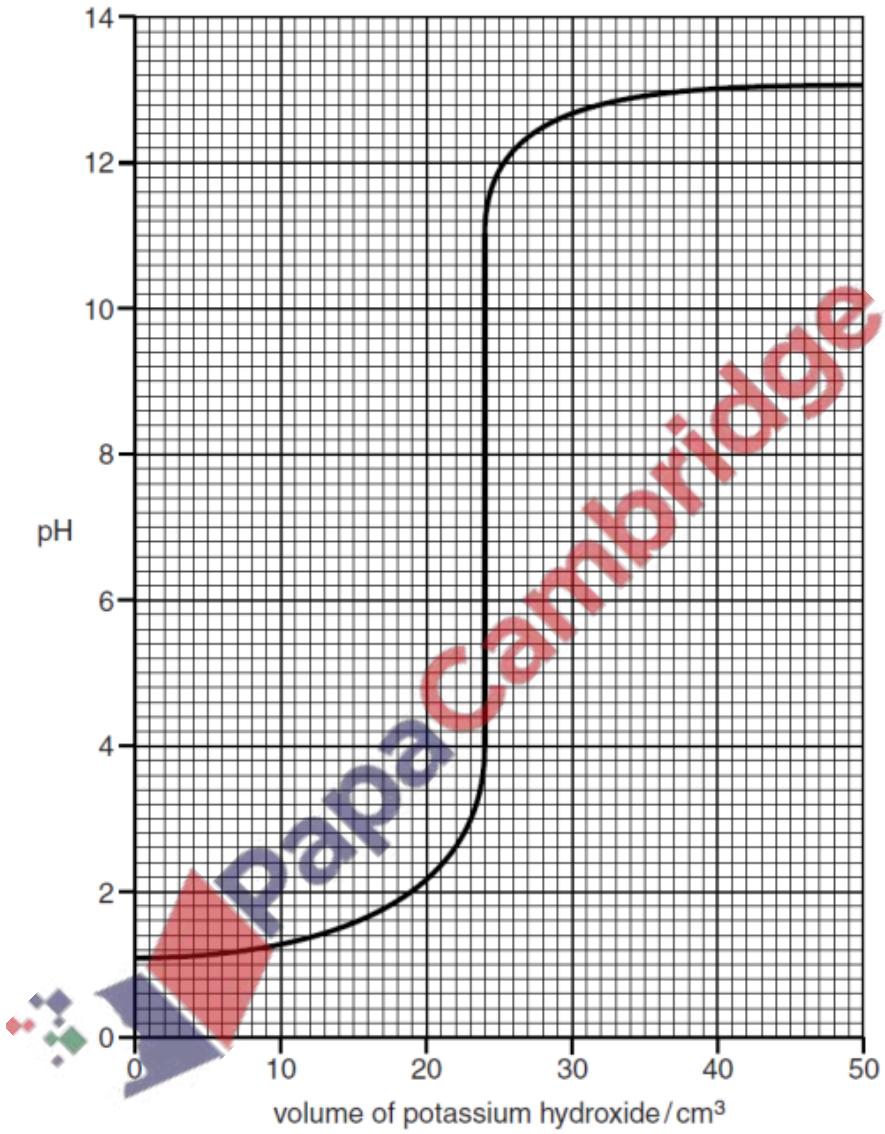
s/12/qp22

Question 86.

A3 Salts are often made by the neutralisation of bases.

(a) Aqueous potassium hydroxide, of concentration 0.150 mol/dm^3, is added to 25.0 cm^3 of sulfuric acid in a flask.

The graph shows how the pH of the liquid in the flask changes as aqueous potassium hydroxide is added to it.



(i) Construct the equation for the complete neutralisation of sulfuric acid by potassium hydroxide.

..... [1]

(ii) Use the graph to deduce the volume of aqueous potassium hydroxide required to neutralise 25.0 cm^3 of sulfuric acid.

..... [1]

(iii) Use your answers to **(i)** and **(ii)** to calculate the concentration of sulfuric acid.

concentration of sulfuric acid = ... mol/dm^3 [3]

s/13/qp21

Question 87.

(c) Sodium chloride is dissolved in distilled water.

Excess aqueous silver nitrate is added to this solution and 0.232 g of a white precipitate is formed.

(i) Construct an ionic equation, including state symbols, for the formation of the white precipitate.

..... [2]

(ii) Calculate the mass of sodium chloride present in the solution.

mass of sodium chloride = ... g [3]

s/13/qp22

Question 88.

(e) Sodium hydroxide is an alkali.

Give the formula of the ion present in sodium hydroxide which causes it to be alkaline.

.....[1]

(f) A student titrated a metal hydroxide with 0.200 mol/dm^3 hydrochloric acid.
It required 12.5 cm^3 of hydrochloric acid to neutralise 25.0 cm^3 of 0.0500 mol/dm^3 metal hydroxide solution.

(i) Calculate the amount, in moles, of hydrochloric acid used.

..... mol [1]

(ii) Calculate the amount, in moles, of metal hydroxide present.

..... mol [1]

(iii) Construct an equation for this reaction.
Use the letter **M** to represent the metal in the metal hydroxide solution.

[1]

(g) Name a metal hydroxide which can be used to treat excess acidity in soils.

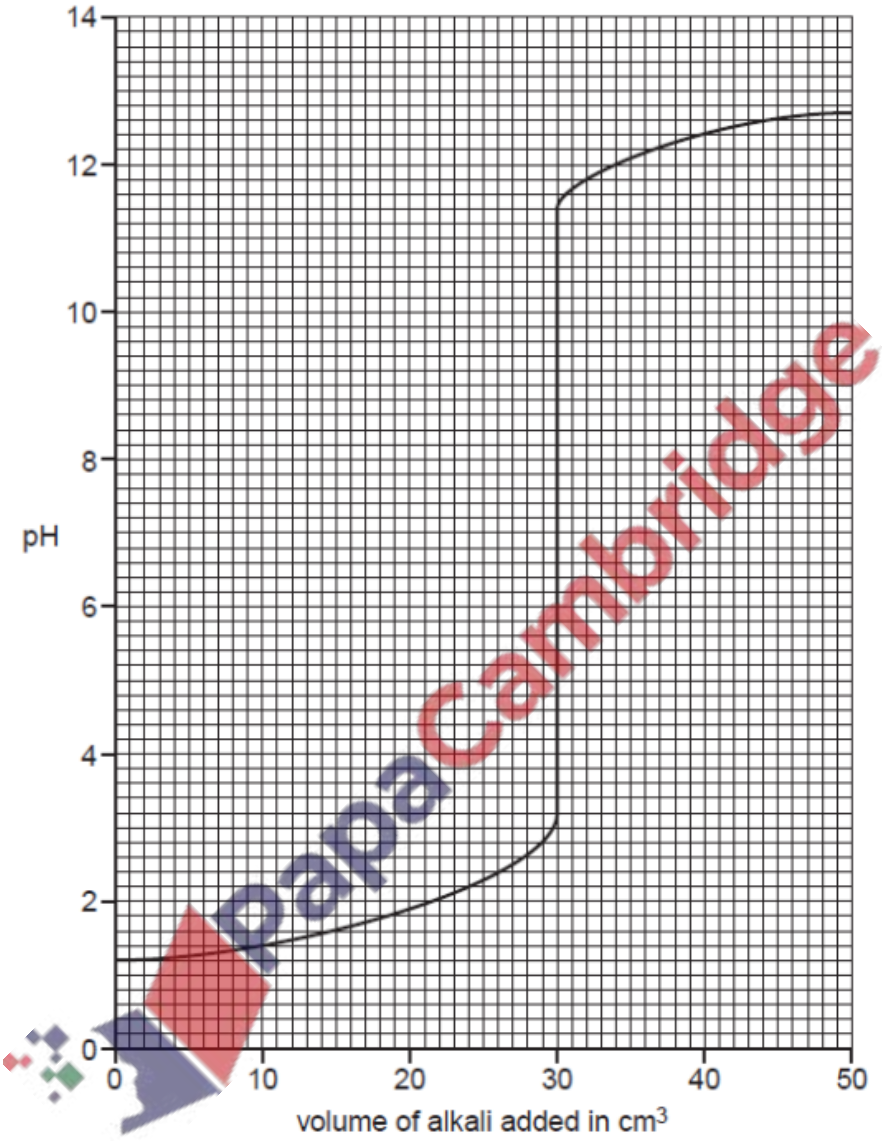
.....[1]

w/13/qp21

Question 89.

A5 Aqueous potassium hydroxide, KOH, is added slowly from a burette into a flask containing 25.0 cm^3 of 0.0500 mol/dm^3 dilute sulfuric acid, H_2SO_4. At the same time the pH of the contents of the flask is measured until all of the aqueous potassium hydroxide has been added.

The graph shows how the pH changes with the addition of the aqueous potassium hydroxide.



(a) What is the pH of 0.0500 mol/dm^3 sulfuric acid?

..... [1]

(b) Construct the equation for the reaction between sulfuric acid and potassium hydroxide.

..... [1]

(c) (i) What volume of aqueous potassium hydroxide has been added when the mixture has a pH of 7?

volume = ... cm^3 [1]

(ii) Calculate the concentration, in mol/dm^3, of the aqueous potassium hydroxide.

concentration = ... mol/dm^3 [3]

(d) The experiment is repeated with 25.0 cm^3 of 0.0500 mol/dm^3 ethanoic acid, CH_3COOH, instead of 25.0 cm^3 of 0.0500 mol/dm^3 sulfuric acid.

Describe and explain any differences in the graph which would be obtained.

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.....

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..... [2]

[Total: 8]