

5070/0620 CIE CHEMISTRY
O' LEVELS – GCE & iGCSE

Acids, Bases & Salts

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Past papers compiled from 2002-2014

MCQs: Acids, Bases & Salts (iGCSE)

32 Which pair of compounds would make a N, P, K fertiliser?

- A ammonium sulfate and potassium phosphate
- B calcium hydroxide and ammonium nitrate
- C calcium phosphate and potassium chloride
- D potassium nitrate and ammonium sulfate.

0620_w/14/qp13

21 Which salt preparation uses a burette and a pipette?

- A calcium nitrate from calcium carbonate and nitric acid
- B copper(II) sulfate from copper(II) hydroxide and sulfuric acid
- C potassium chloride from potassium hydroxide and hydrochloric acid
- D zinc chloride from zinc and hydrochloric acid

0620_w/14/qp13

20 Which statement about oxides is correct?

- A A solution of magnesium oxide will have a pH less than 7.
- B A solution of sulfur dioxide will have a pH greater than 7.
- C Magnesium oxide will react with nitric acid to make a salt.
- D Sulfur dioxide will react with hydrochloric acid to make a salt.

0620_w/14/qp13

19 A colourless solution is tested by the following reactions.

Which reaction is **not** characteristic of an acid?

- A A piece of magnesium ribbon is added. Bubbles are seen and the magnesium disappears.
- B A pungent smelling gas is produced when ammonium carbonate is added.
- C Copper oxide powder is added and the mixture is warmed. The solution turns blue.
- D The solution turns blue litmus red.

0620_w/14/qp13

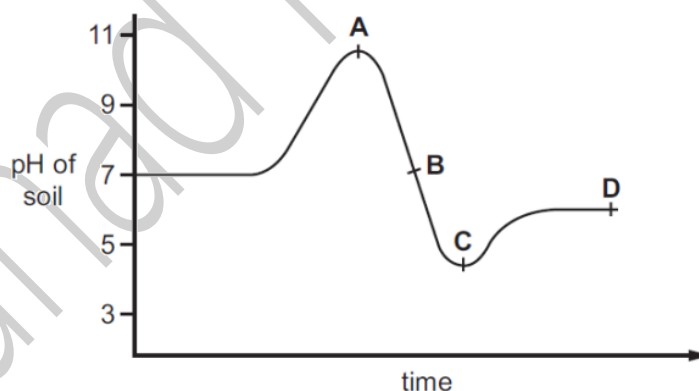
32 Which method can be used to obtain ammonia from ammonium sulfate?

- A Heat it with an acid.
- B Heat it with an alkali.
- C Heat it with an oxidising agent.
- D Heat it with a reducing agent.

0620_w/14/qp11

22 The graph shows how the pH of soil in a field changes over time.

At which point was the soil neutral?



0620_w/14/qp11

21 How many different salts could be made from a supply of dilute sulfuric acid, dilute hydrochloric acid, copper, magnesium oxide and zinc carbonate?

- A 3
- B 4
- C 5
- D 6

0620_w/14/qp11

20 The positions of elements W, X, Y and Z in the Periodic Table are shown.

Which elements form basic oxides?

- A** W, X and Y **B** W and X only **C** Y only **D** Z only

0620_w/14/qp11

19 Which substance is the most acidic?

	substance	pH
A	calcium hydroxide	12
B	lemon juice	4
C	milk	6
D	washing up liquid	8

0620_w/14/qp11

31 A sample of fertiliser is tested by warming it with aqueous sodium hydroxide.

A colourless gas is produced which turns red litmus paper blue.

Which element, essential for plant growth, must be present?

- A** nitrogen
B phosphorus
C potassium
D sulfur

0620_w/13/qp13

30 Carbon dioxide is produced when

X reacts with ethanol.

Y reacts with sodium carbonate.

What are X and Y?

	X	Y
A	H ₂	HCl
B	H ₂	NaOH
C	O ₂	HCl
D	O ₂	NaOH

0620_w/13/qp13

20 The cations shown are identified by the colour of the precipitates formed when an excess of an aqueous solution of X is added.

cations present	effect of adding an excess of aqueous X
iron(II) (Fe ²⁺)	green precipitate
copper(II) (Cu ²⁺)	light blue precipitate
iron(III) (Fe ³⁺)	red-brown precipitate

What is X?

- A** ammonia
- B** limewater
- C** silver nitrate
- D** sodium hydroxide

0620_w/13/qp13

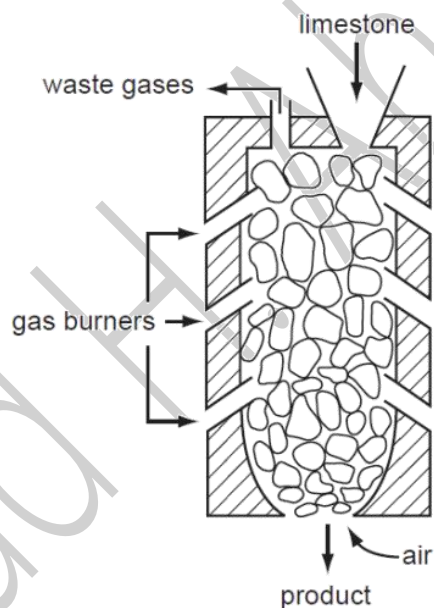
18 Which are properties of an acid?

- 1 reacts with ammonium sulfate to form ammonia
- 2 turns red litmus blue

	1	2
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_w/13/qp13

35 The diagram shows a kiln used to heat limestone.



What is the product and what waste gas is formed?

	product	waste gas
A	lime, CaO	carbon monoxide
B	lime, CaO	carbon dioxide
C	slaked lime, Ca(OH) ₂	carbon monoxide
D	slaked lime, Ca(OH) ₂	carbon dioxide

0620_w/13/qp11

31 Farmers add calcium oxide (lime) and ammonium salts to their fields.

The compounds are not added at the same time because they react with each other.

Which gas is produced in this reaction?

- A** ammonia
- B** carbon dioxide
- C** hydrogen
- D** nitrogen

0620_w/13/qp11

20 Compound X is tested and the results are shown in the table.

test	result
aqueous sodium hydroxide is added, then heated gently	gas given off which turns damp red litmus paper blue
dilute hydrochloric acid is added	effervescence, gas given off which turns limewater milky

Which ions are present in compound X?

- A** ammonium ions and carbonate ions
- B** ammonium ions and chloride ions
- C** calcium ions and carbonate ions
- D** calcium ions and chloride ions

0620_w/13/qp11

19 Which of the following are properties of the oxides of non-metals?

	property 1	property 2
A	acidic	covalent
B	acidic	ionic
C	basic	covalent
D	basic	ionic

0620_w/13/qp11

18 Which are properties of an acid?

- 1 reacts with ammonium sulfate to form ammonia
- 2 turns red litmus blue

	1	2
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_w/13/qp11

34 Two industrial processes that involve heating are

- extracting iron from its ore using a blast furnace,
- making lime.

In which of these processes is calcium carbonate used?

	extracting iron	making lime
A	✓	✓
B	✓	x
C	x	✓
D	x	x

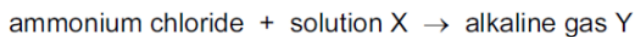
0620_w/12/qp13

33 Which process does **not** produce carbon dioxide?

- A** combustion of petrol
- B** reaction between an acid and a metal hydroxide
- C** reaction between an acid and a carbonate
- D** respiration

0620_w/12/qp13

32 What are X and Y in the reaction shown?

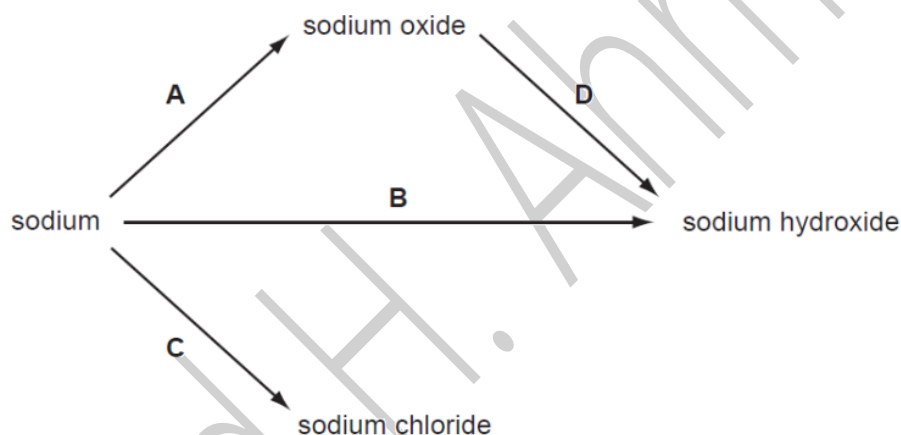


	X	Y
A	hydrochloric acid	ammonia
B	hydrochloric acid	chlorine
C	sodium hydroxide	ammonia
D	sodium hydroxide	chlorine

0620_w/12/qp13

17 Some reactions involving sodium are shown.

Which reaction does **not** involve the formation of a base?



0620_w/12/qp13

16 Salts X and Y are separately dissolved in water.

Samples of the solutions obtained are separately tested with dilute hydrochloric acid and with aqueous sodium hydroxide.

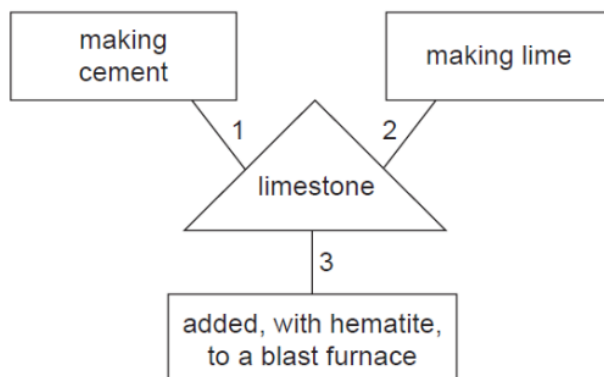
In two of the tests, a gaseous product is formed. No precipitate is formed in any of the tests.

What are salts X and Y?

	X	Y
A	AgNO ₃	BaSO ₄
B	BaSO ₄	Na ₂ CO ₃
C	Na ₂ CO ₃	NH ₄ Cl
D	NH ₄ Cl	AgNO ₃

0620_w/12/qp13

34 A student is asked to draw a diagram showing the uses of limestone.



Which numbered lines show a correct use of limestone?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

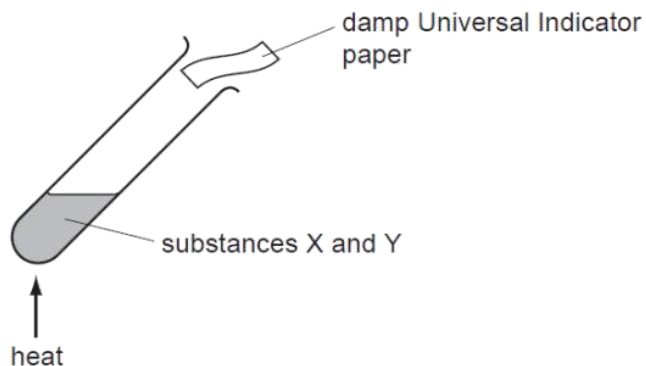
0620_w/12/qp11

33 Carbon dioxide is produced when dilute hydrochloric acid reacts with

- A calcium sulfate.
- B carbon.
- C copper(II) carbonate.
- D limewater.

0620_w/12/qp11

32 The diagram shows two substances, X and Y, being heated together.



The Universal Indicator paper turns blue during the experiment.

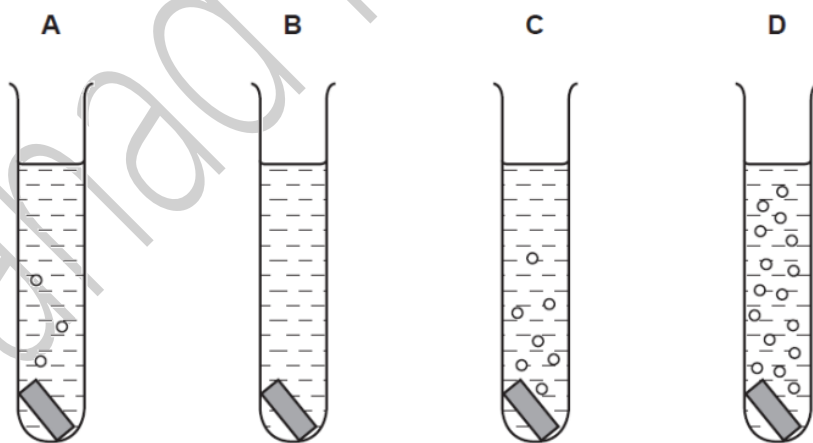
What are substances X and Y?

- A ammonium nitrate and hydrochloric acid
- B ammonium nitrate and sodium hydroxide
- C sodium carbonate and hydrochloric acid
- D sodium carbonate and sodium hydroxide

0620_w/12/qp11

27 Pieces of copper, iron, magnesium and zinc are added to separate test-tubes containing dilute hydrochloric acid.

Which test-tube contains iron and dilute hydrochloric acid?



0620_w/12/qp11

18 Barium hydroxide is an alkali. It reacts with hydrochloric acid.

How does the pH of the hydrochloric acid change as an excess of aqueous barium hydroxide is added?

- A The pH decreases from 14 and becomes constant at 7.
- B The pH decreases from 14 to about 1.
- C The pH increases from 1 and becomes constant at 7.
- D The pH increases from 1 to about 14.

0620_w/12/qp11

19 A compound is a salt if it

- A can neutralise an acid.
- B contains more than one element.
- C dissolves in water.
- D is formed when an acid reacts with a base.

0620_w/12/qp11

17 Element X forms an acidic, covalent oxide.

Which row shows how many electrons there could be in the outer shell of an atom of X?

	1	2	6	7
A	✓	✓	x	x
B	✓	x	✓	x
C	x	x	✓	✓
D	x	✓	x	✓

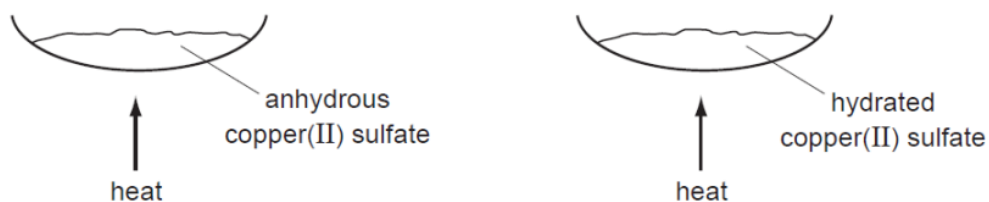
0620_w/12/qp11

16 Which of these pairs of aqueous ions **both** react with dilute sulfuric acid to give a visible result?

- A Ba^{2+} and Cl^-
- B Ba^{2+} and CO_3^{2-}
- C NH_4^+ and Cl^-
- D NH_4^+ and CO_3^{2-}

0620_w/12/qp11

13 Separate samples of anhydrous and hydrated copper(II) sulfate are heated.

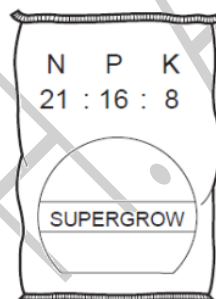


Which shows the correct colour changes?

	anhydrous copper(II) sulfate	hydrated copper(II) sulfate
A	blue to white	white to blue
B	no change	blue to white
C	white to blue	blue to white
D	white to blue	no change

0620_w/12/qp11

34 Which combination of chemical compounds could be used to produce the fertiliser shown?



- A** NH_4NO_3 , $\text{Ca}_3(\text{PO}_4)_2$
- B** NH_4NO_3 , $\text{CO}(\text{NH}_2)_2$
- C** NH_4NO_3 , K_2SO_4 , $(\text{NH}_4)_2\text{SO}_4$
- D** $(\text{NH}_4)_3\text{PO}_4$, KCl

0620_w/11/qp11

20 The results of three tests on a solution of compound **X** are shown.

test	result
aqueous sodium hydroxide added	white precipitate formed, soluble in excess
aqueous ammonia added	white precipitate formed, soluble in excess
dilute hydrochloric acid added	bubbles of gas

What is compound **X**?

- A aluminium carbonate
- B aluminium chloride
- C zinc carbonate
- D zinc chloride

0620_w/11/qp11

17 Which type of reaction always forms a salt and water?

- A exothermic
- B neutralisation
- C oxidation
- D polymerisation

0620_w/11/qp11

18 Which property is **not** characteristic of a base?

- A It reacts with a carbonate to form carbon dioxide.
- B It reacts with an acid to form a salt.
- C It reacts with an ammonium salt to form ammonia.
- D It turns universal indicator paper blue.

0620_w/11/qp11

19 An alloy contains copper and zinc.

Some of the zinc has become oxidised to zinc oxide.

What is the result of adding an excess of dilute sulfuric acid to the alloy?

- A A blue solution and a white solid remains.
- B A colourless solution and a pink/brown solid remains.
- C The alloy dissolves completely to give a blue solution.
- D The alloy dissolves completely to give a colourless solution.

0620_w/11/qp11

35 A bag of fertiliser 'Watch it grow' contains ammonium sulfate and potassium sulfate.

Which of the three elements N, P and K does 'Watch it grow' contain?

	N	P	K
A	✓	✓	x
B	✓	x	✓
C	x	✓	x
D	x	x	✓

0620_w/10/qp11

22 A salt is made by adding an excess of an insoluble metal oxide to an acid.

How can the excess metal oxide be removed?

- A chromatography
- B crystallisation
- C distillation
- D filtration

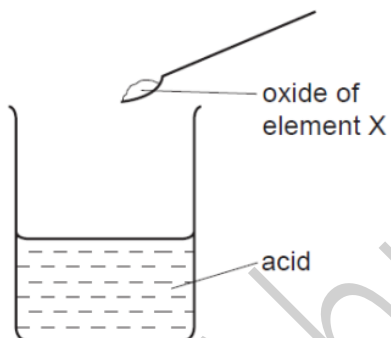
0620_w/10/qp11

20 Which reaction will result in a decrease in pH?

- A adding calcium hydroxide to acid soil
- B adding citric acid to sodium hydrogen carbonate solution
- C adding sodium chloride to silver nitrate solution
- D adding sodium hydroxide to hydrochloric acid

0620_w/10/qp11

21 The oxide of element X was added to an acid. It reacted to form a salt and water.



What is the pH of the acid before the reaction and what type of element is X?

	pH	type of element X
A	greater than 7	metal
B	greater than 7	non-metal
C	less than 7	metal
D	less than 7	non-metal

0620_w/10/qp11

19 Some barium iodide is dissolved in water.

Aqueous lead(II) nitrate is added to the solution until no more precipitate forms.

This precipitate, X, is filtered off.

Dilute sulfuric acid is added to the filtrate and another precipitate, Y, forms.

What are the colours of precipitates X and Y?

	X	Y
A	white	white
B	white	yellow
C	yellow	white
D	yellow	yellow

0620_w/10/qp11

36 Fertilisers are used to provide three of the elements needed for plant growth.

Which two compounds would give a fertiliser containing all three of these elements?

A $\text{Ca}(\text{NO}_3)_2$ and $(\text{NH}_4)_2\text{SO}_4$

B $\text{Ca}(\text{NO}_3)_2$ and $(\text{NH}_4)_3\text{PO}_4$

C KNO_3 and $(\text{NH}_4)_2\text{SO}_4$

D KNO_3 and $(\text{NH}_4)_3\text{PO}_4$

0620_w/09/qp11

20 An aqueous solution Y contains both barium ions and silver ions.

In separate experiments, dilute sulfuric acid and dilute hydrochloric acid are added to solution Y.

Which of these acids causes a precipitate to form in solution Y?

	dilute sulfuric acid	dilute hydrochloric acid
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_w/09/qp11

21 The diagram shows the pH values of four solutions.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			↑			↑		↑				↑	
			P			Q		R				S	

Which of these solutions are alkaline?

- A P only
- B P and Q only
- C Q, R and S only
- D R and S only

0620_w/09/qp11

16 When an acid is added to an alkali the temperature rises.

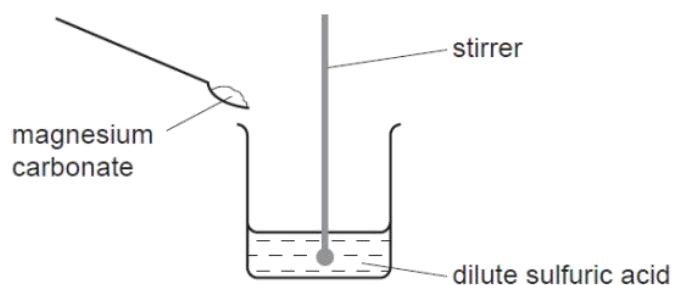
Which words describe this reaction?

- A decomposition and endothermic
- B decomposition and exothermic
- C neutralisation and endothermic
- D neutralisation and exothermic

0620_w/09/qp11

2 A student carries out an experiment to prepare pure magnesium sulfate crystals.

The diagram shows the first stage of the preparation.



He adds magnesium carbonate until no more reacts.

Which process should he use for the next stage?

- A crystallisation
- B evaporation
- C filtration
- D neutralisation

0620_w/09/qp11

37 When added in turn to four solutions, aqueous sodium carbonate gives the following results.

Which solution is acidic?

solution	result
A	a blue precipitate forms
B	a white precipitate forms
C	bubbles of gas form
D	no visible reaction occurs

0620_w/08/qp1

20 Dilute hydrochloric acid is added to aqueous barium nitrate in a test-tube.

What happens?

	the pH of the liquid in the test-tube	a precipitate forms
A	decreases	yes
B	decreases	no
C	increases	yes
D	increases	no

0620_w/08/qp1

21 A colourless liquid in an unlabelled bottle is tested as shown.

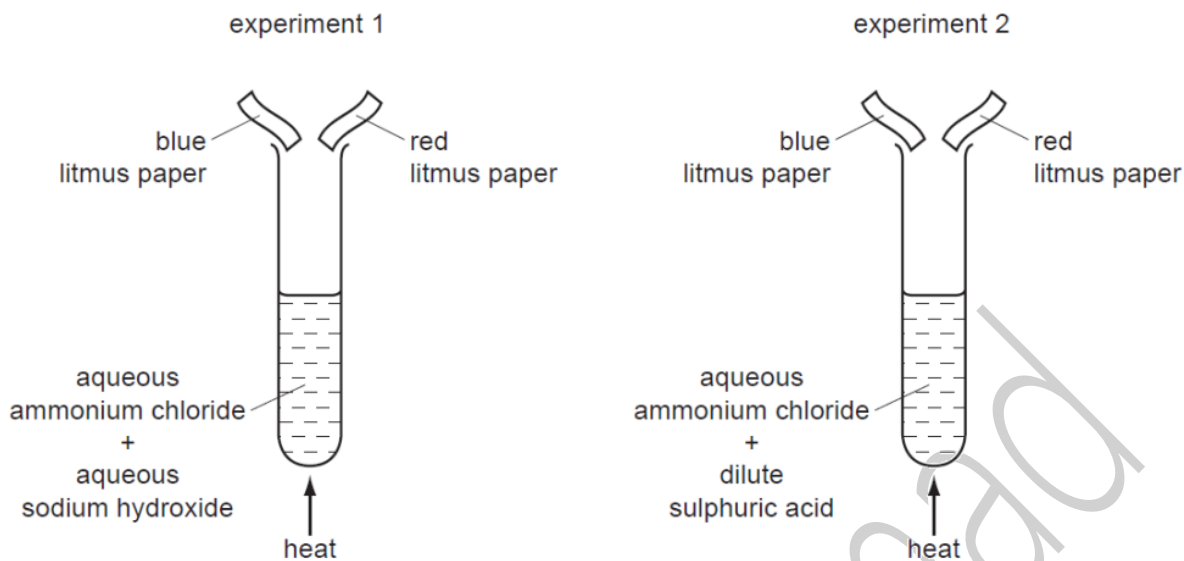
- Litmus paper turns red.
- Magnesium ribbon fizzed.
- Reaction with aqueous barium nitrate produced a white precipitate.

What is the colourless liquid?

- A** aqueous sodium hydroxide
- B** aqueous sodium sulphate
- C** dilute hydrochloric acid
- D** dilute sulphuric acid

0620_w/08/qp1

22 The diagrams show two experiments.



What happens to the pieces of litmus paper?

	experiment 1	experiment 2
A	blue → red	both pieces bleached
B	blue → red	no change
C	red → blue	both pieces bleached
D	red → blue	no change

0620_w/08/qp1

23 Which substances react with dilute sulphuric acid to form a salt?

	magnesium	magnesium oxide	magnesium carbonate	magnesium chloride
A	✓	✓	✓	x
B	✓	✓	x	✓
C	✓	x	✓	✓
D	x	✓	✓	✓

0620_w/08/qp1

3 An aqueous solution contains barium iodide.

It is possible to obtain a solution that contains $\text{Ba}^{2+}(\text{aq})$ but no $\text{I}^{-}(\text{aq})$ by adding1..... until no more2..... precipitate forms.

Which words correctly complete gaps 1 and 2?

	1	2
A	aqueous lead(II) nitrate	white
B	aqueous lead(II) nitrate	yellow
C	dilute sulphuric acid	white
D	dilute sulphuric acid	yellow

0620_w/08/qp1

15 A gas is escaping from a pipe in a chemical plant.

A chemist tests this gas and finds that it is alkaline.

What is this gas?

- A** ammonia
- B** chlorine
- C** hydrogen
- D** sulfur dioxide

0620_s/12/qp11

16 The results of three tests on a solution of compound X are shown in the table.

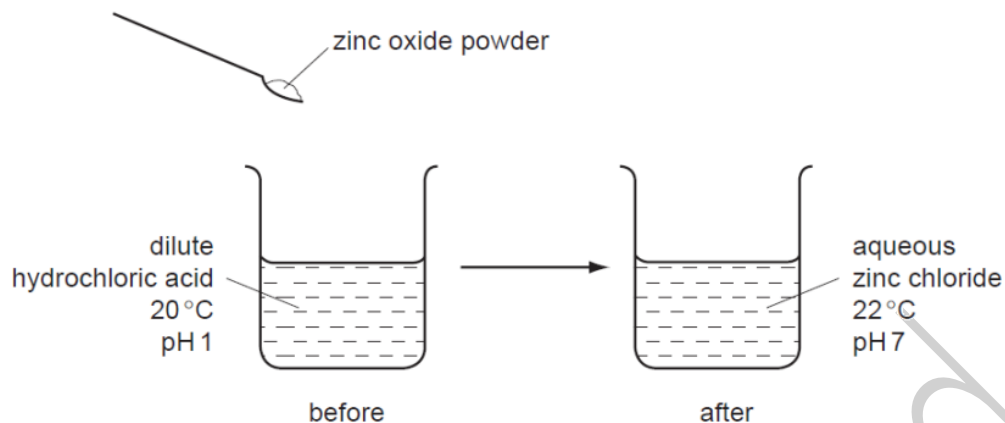
test	result
aqueous sodium hydroxide added	white precipitate formed, soluble in excess
aqueous ammonia added	white precipitate formed, insoluble in excess
acidified silver nitrate added	white precipitate formed

What is compound X?

- A** aluminium bromide
- B** aluminium chloride
- C** zinc bromide
- D** zinc chloride

0620_s/12/qp11

12 The diagram shows the reaction between zinc oxide and dilute hydrochloric acid.



Which terms describe the reaction?

	endothermic	neutralisation
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_s/12/qp11

34 Which two substances, when reacted together, would form a salt that contains two of the essential elements provided by fertilisers?

- A** potassium hydroxide and nitric acid
- B** potassium hydroxide and sulfuric acid
- C** sodium hydroxide and nitric acid
- D** sodium hydroxide and sulfuric acid

0620_s/11/qp11

19 A solution contains barium ions and silver ions.

What could the anion be?

- A** chloride only
- B** nitrate only
- C** sulfate only
- D** chloride or nitrate or sulfate

0620_s/11/qp11

20 A mixture containing two anions was tested and the results are shown below.

test	result
dilute nitric acid added	effervescence of a gas which turned limewater milky
dilute nitric acid added, followed by aqueous silver nitrate	yellow precipitate formed

Which anions were present?

- A carbonate and chloride
- B carbonate and iodide
- C sulfate and chloride
- D sulfate and iodide

0620_s/11/qp11

17 Carbon dioxide is an acidic oxide that reacts with aqueous calcium hydroxide.

Which type of reaction takes place?

- A decomposition
- B fermentation
- C neutralisation
- D oxidation

0620_s/11/qp11

18 Which is **not** a typical property of an acid?

- A They react with alkalis producing water.
- B They react with all metals producing hydrogen.
- C They react with carbonates producing carbon dioxide.
- D They turn litmus paper red.

0620_s/11/qp11

35 To grow roses, a fertiliser containing nitrogen, phosphorus and potassium is needed.

For the best flowers, the fertiliser should contain a high proportion of potassium.

Which fertiliser is best for roses?

fertiliser	proportion by mass		
	N	P	K
A	9	0	25
B	13	13	20
C	29	5	0
D	29	15	5

0620_s/10/qp11

22 An excess of copper(II) oxide is added to dilute sulfuric acid to make crystals of hydrated copper(II) sulfate.

The processes listed may be used to obtain crystals of hydrated copper(II) sulfate.

- 1 concentrate the resulting solution
- 2 filter
- 3 heat the crystals
- 4 wash the crystals

Which processes are needed and in which order?

- A** 1, 2, 3 and 4
B 1, 2, 4 and 3
C 2, 1, 2 and 3
D 2, 1, 2 and 4

0620_s/10/qp11

19 Aqueous sodium hydroxide is added to a solid, X, and the mixture is heated.

A green precipitate is formed and an alkaline gas is given off.

Which ions are present in X?

- A NH_4^+ and Fe^{2+}
- B NH_4^+ and Fe^{3+}
- C OH^- and Fe^{2+}
- D OH^- and Fe^{3+}

0620_s/10/qp11

20 An aqueous solution of the organic compound methylamine has a pH greater than 7.

Which statement about methylamine is correct?

- A It neutralises an aqueous solution of sodium hydroxide.
- B It reacts with copper(II) carbonate to give carbon dioxide.
- C It reacts with hydrochloric acid to form a salt.
- D It turns blue litmus red.

0620_s/10/qp11

36 Which element is **not** added to a fertiliser?

- A aluminium
- B nitrogen
- C phosphorus
- D potassium

0620_s/09/qp11

32 Substance K reacts with sodium carbonate to form a gas.

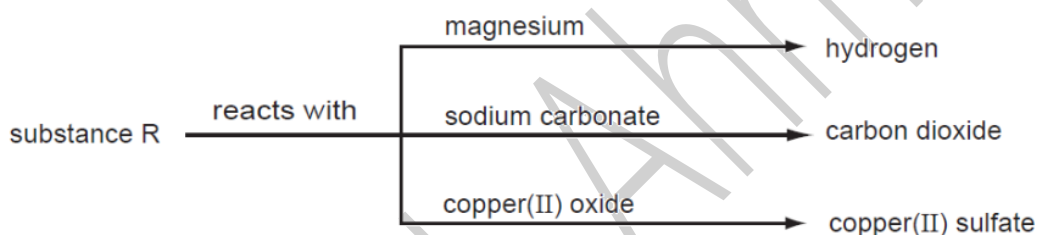
The gas turns limewater cloudy.

What is substance K and which process takes place in the reaction?

	K	process
A	ethanol	combustion
B	ethanol	neutralisation
C	hydrochloric acid	combustion
D	hydrochloric acid	neutralisation

0620_s/09/qp11

23 Some reactions of a substance, R, are shown in the diagram.



What type of substance is R?

- A** an acid
- B** a base
- C** an element
- D** a salt

0620_s/09/qp11

22 An element E is burned in air. A white solid oxide is formed.

The oxide is tested with damp red litmus paper. The paper turns blue.

What is element E?

- A** calcium
- B** carbon
- C** iodine
- D** sulfur

0620_s/09/qp11

20 Aqueous sodium hydroxide is added to a solution of a salt. A blue precipitate is formed which does not dissolve in excess.

Aluminium foil is added to the mixture and the mixture is warmed. A gas is produced that turns damp red litmus paper blue.

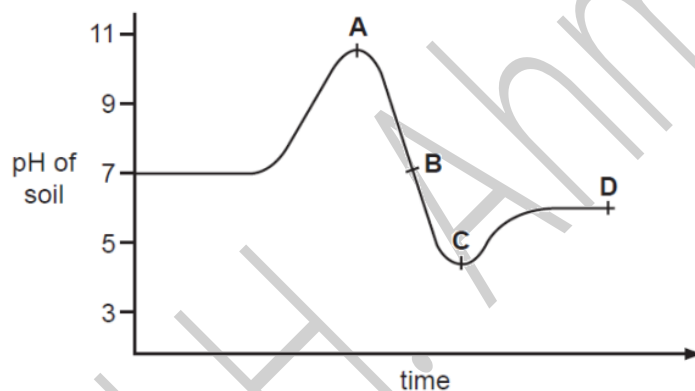
What is the name of the salt?

- A** ammonium nitrate
- B** ammonium sulfate
- C** copper(II) nitrate
- D** copper(II) sulfate

0620_s/09/qp11

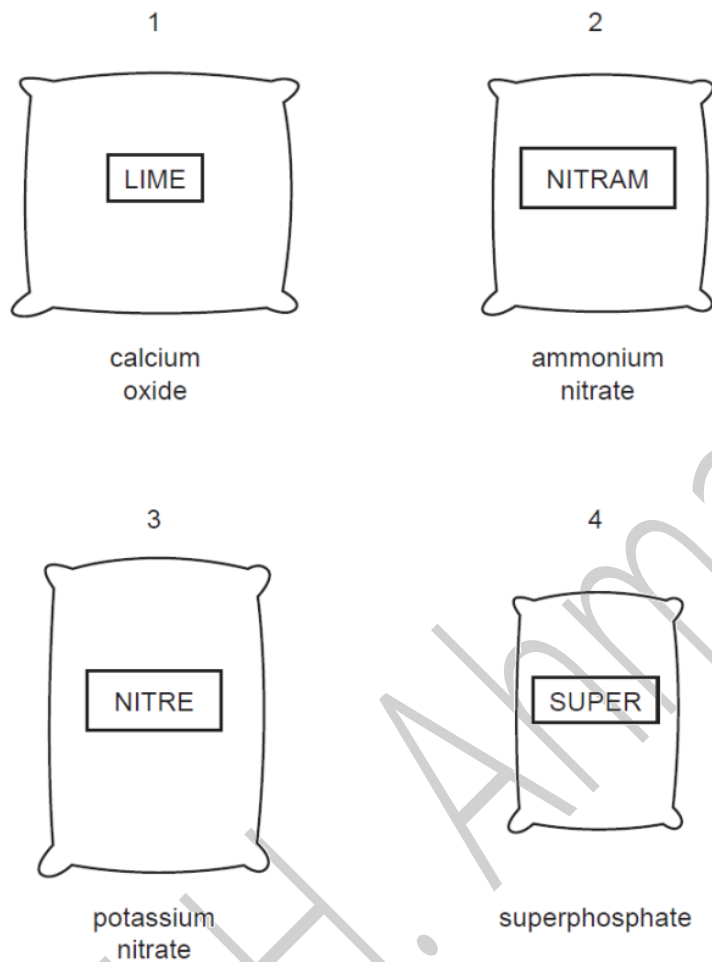
21 The graph shows how the pH of soil in a field changed over time.

At which point was the soil neutral?



0620_s/09/qp11

35 The diagrams show four sacks which a farmer has in his barn.



Which sacks should be mixed to make a complete fertiliser, containing all the essential elements needed by plants?

- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

0620_s/08/qp1

36 Which of the following does **not** produce carbon dioxide?

- A** adding hydrochloric acid to carbon
B adding hydrochloric acid to potassium carbonate
C burning coke
D burning petrol

0620_s/08/qp1

21 Which statement describes a test for carbon dioxide gas?

- A It bleaches damp litmus paper.
- B It relights a glowing splint.
- C It turns cobalt(II) chloride paper pink.
- D It turns limewater cloudy.

0620_s/08/qp1

22 A solution of zinc sulphate can be made by adding an excess **either** of zinc carbonate **or** of zinc hydroxide to dilute sulphuric acid.

In which forms are these zinc compounds added to the acid?

	zinc carbonate	zinc hydroxide
A	aqueous	aqueous
B	aqueous	solid
C	solid	aqueous
D	solid	solid

0620_s/08/qp1

23 Which aqueous ion causes a white precipitate to form when acidified aqueous silver nitrate is added to it?

- A chloride
- B iodide
- C nitrate
- D sulphate

0620_s/08/qp1

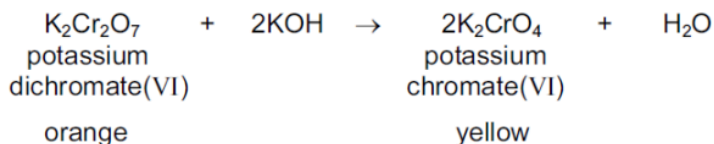
20 An oxide of element X dissolves in water to form a solution of pH 5.

Which line in the table is correct?

	type of element	type of oxide
A	metallic	acidic
B	metallic	basic
C	non-metallic	acidic
D	non-metallic	basic

0620_s/08/qp1

- 19 The equation explains the colour change that occurs when aqueous potassium hydroxide is added to aqueous potassium dichromate(VI).

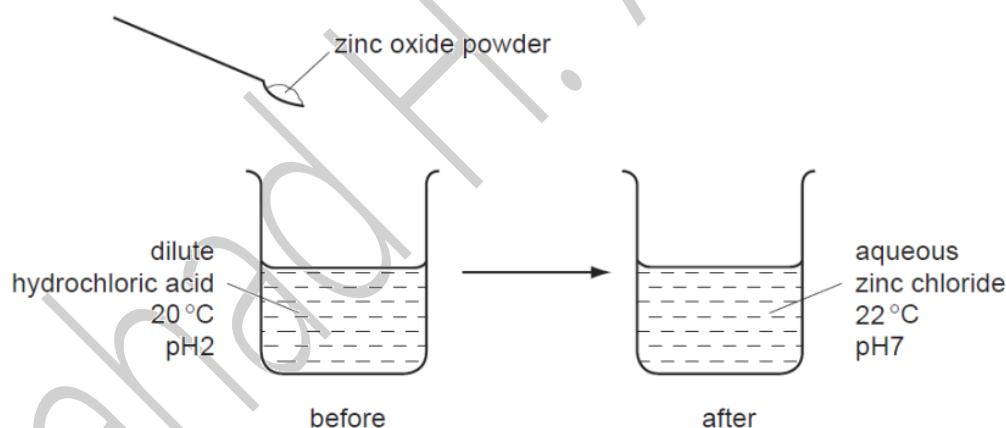


As a result of adding an excess of aqueous potassium hydroxide to aqueous potassium dichromate(VI), what happens to the oxidation state of the chromium and the pH of the reaction mixture?

	oxidation state of the chromium	pH of the mixture
A	decreases	decreases
B	decreases	increases
C	stays the same	decreases
D	stays the same	increases

0620_s/08/qp1

- 15 The diagram shows an experiment.



Which terms describe the experiment?

	endothermic	neutralisation
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_s/08/qp1

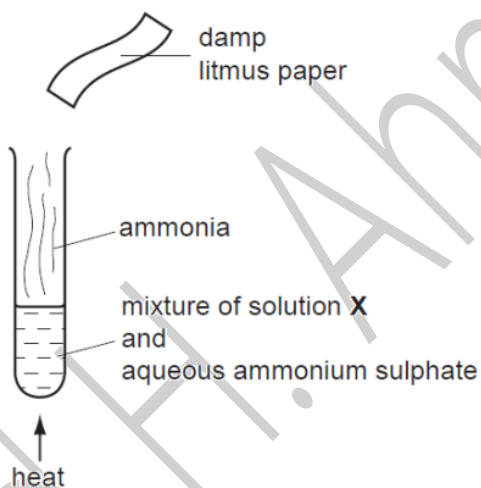
36 When limestone is heated very strongly in air, lime is made.

What is the formula of limestone and of lime?

	limestone	lime
A	CaCO_3	CaO
B	CaCO_3	Ca(OH)_2
C	CaO	CaCO_3
D	Ca(OH)_2	CaCO_3

0620_s/07/qp1

34 The diagram shows an experiment in which ammonia is released.



Which line in the table is correct?

	solution X	final colour of litmus paper
A	aqueous sodium hydroxide	blue
B	aqueous sodium hydroxide	red
C	dilute sulphuric acid	blue
D	dilute sulphuric acid	red

0620_s/07/qp1

35 A bag of fertiliser 'Watch it grow' contains ammonium sulphate and potassium sulphate.

Which of the three elements N, P and K does 'Watch it grow' contain?

	N	P	K
A	✓	✓	✗
B	✓	✗	✓
C	✗	✗	✓
D	✗	✓	✗

0620_s/07/qp1

21 Two indicators, bromophenol blue and Congo red, show the following colours in acidic solutions and in alkaline solutions.

indicator	acid	alkali
bromophenol blue	yellow	blue
Congo red	violet	red

A few drops of each indicator are added to separate samples of a solution of pH 2.

What are the colours of the indicators in this solution?

	in a solution of pH 2	
	bromophenol blue is	Congo red is
A	blue	red
B	blue	violet
C	yellow	red
D	yellow	violet

0620_s/07/qp1

22 Aqueous lead(II) nitrate is added to a solution containing iodide ions. Lead(II) iodide is formed.

Which type of reaction takes place?

- A** neutralisation
- B** oxidation
- C** precipitation
- D** reduction

0620_s/07/qp1

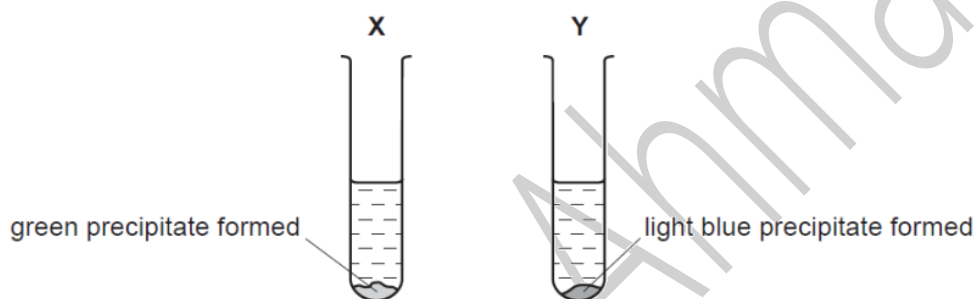
- 18 Aqueous sodium hydroxide and aqueous ammonia each give a white precipitate when added to aqueous zinc sulphate.

What happens when an excess of each of these reagents is added?

	excess NaOH(aq)	excess NH ₃ (aq)
A	precipitate dissolves	precipitate dissolves
B	precipitate dissolves	precipitate does not dissolve
C	precipitate does not dissolve	precipitate dissolves
D	precipitate does not dissolve	precipitate does not dissolve

0620_s/07/qp1

- 19 Aqueous sodium hydroxide is added to two different solutions with the results shown.

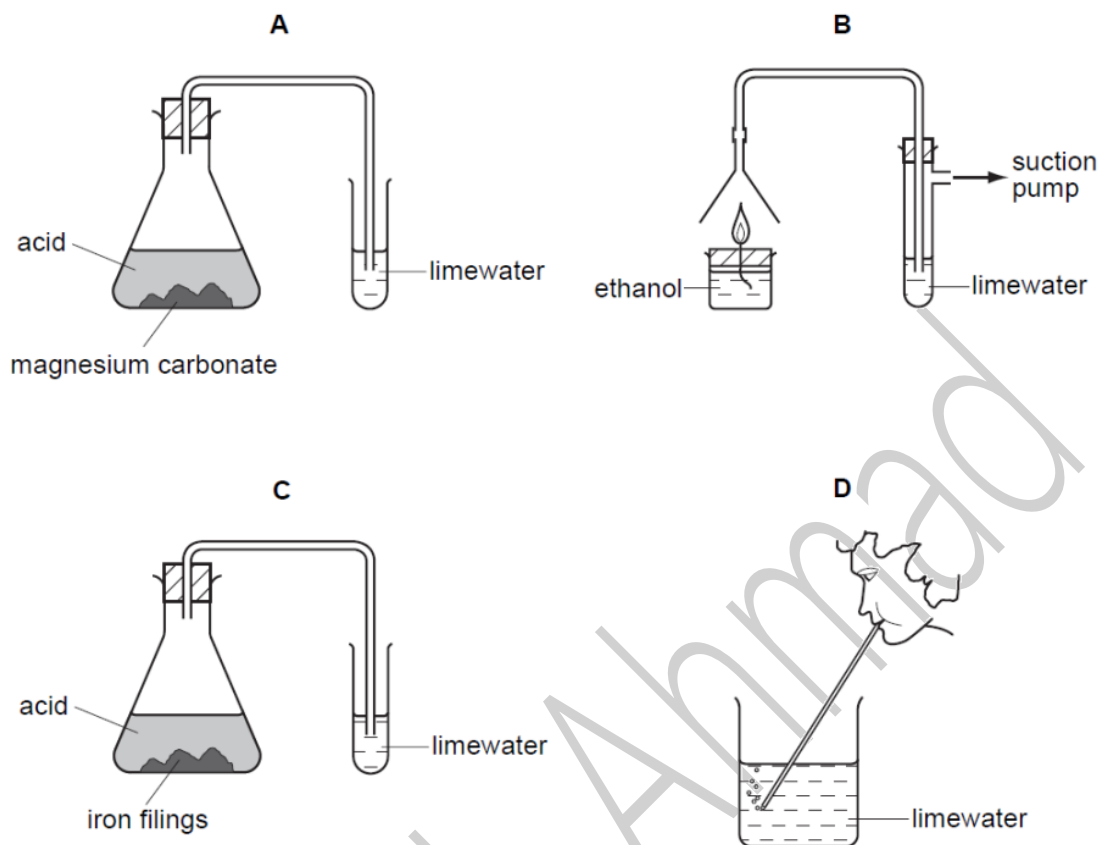


What are the cations present in X and Y?

	X	Y
A	copper(II)	iron(II)
B	copper(II)	iron(III)
C	iron(II)	copper(II)
D	iron(III)	copper(II)

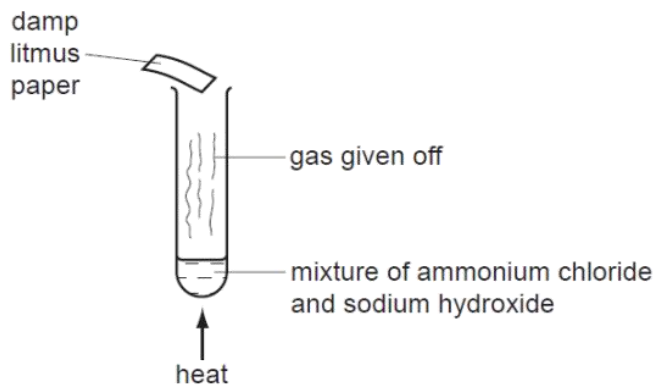
0620_s/07/qp1

20 In which experiment does the limewater **not** turn milky?



0620_s/07/qp1

33 The diagram shows an experiment.

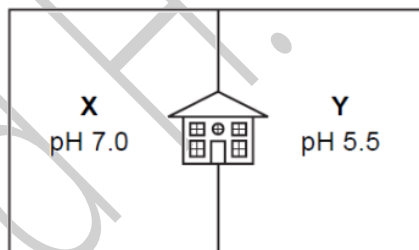


What is the name of the gas and the final colour of the litmus paper?

	gas	colour
A	ammonia	blue
B	ammonia	red
C	chlorine	white
D	chlorine	red

0620_s/06/qp1

34 The diagram shows the pH values of the soil in **X** and **Y**, two parts of the garden of a house.



The house owner wishes to use lime to neutralise the soil in one part of the garden.

To which part should the lime be added, and why?

	part of garden	because lime is
A	X	acidic
B	X	basic
C	Y	acidic
D	Y	basic

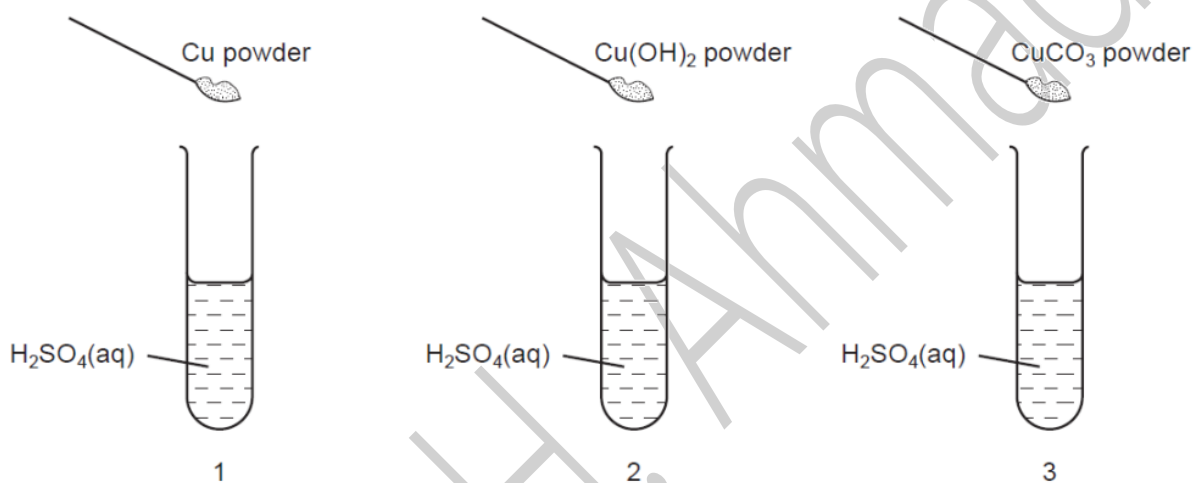
0620_s/06/qp1

31 Which metallic element is needed in a complete fertiliser?

- A calcium
- B magnesium
- C potassium
- D sodium

0620_s/06/qp1

19 The diagrams show three experiments using dilute sulphuric acid. Three different powders are added to the acid.



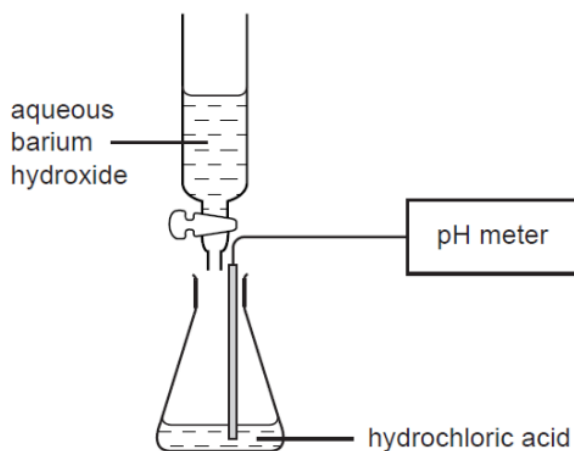
The mixtures are stirred.

Which test-tubes then contain $\text{Cu}^{2+}(\text{aq})$ ions?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

0620_s/06/qp1

16 Barium hydroxide is an alkali. It reacts with hydrochloric acid.



What happens to the pH of a solution of hydrochloric acid as an excess of aqueous barium hydroxide is added?

- A The pH decreases from 14 but becomes constant at 7.
- B The pH decreases from 14 to about 1.
- C The pH increases from 1 but becomes constant at 7.
- D The pH increases from 1 to about 14.

0620_s/06/qp1

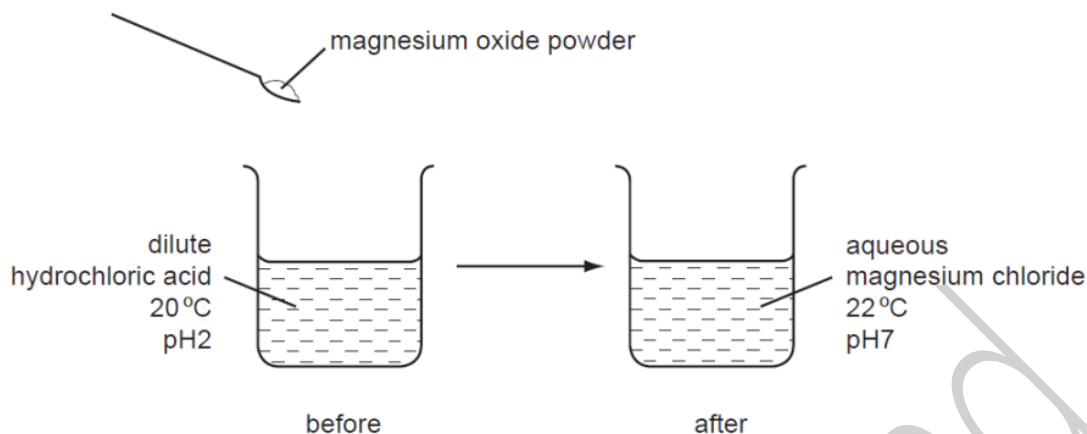
17 Element X is at the left-hand side of the Periodic Table.

Which line in the table shows the correct type and property of the oxide of X?

	type of oxide	property of oxide
A	metallic	acidic
B	metallic	basic
C	non-metallic	acidic
D	non-metallic	basic

0620_s/06/qp1

- 12 The diagram shows an experiment in which magnesium oxide powder is added to dilute hydrochloric acid.



Which terms describe the experiment?

	exothermic	neutralisation
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_s/06/qp1

- 34 The presence of nitrates in soil can be shown by warming the soil with aqueous sodium hydroxide and aluminium foil.

Which gas is given off?

- A** ammonia
- B** carbon dioxide
- C** nitrogen
- D** nitrogen dioxide

0620_s/05/qp1

- 19 Which property does hydrochloric acid have?

- A** It gives a pale blue precipitate with aqueous copper(II) sulphate.
- B** It gives a white precipitate with aqueous barium nitrate.
- C** It releases ammonia from aqueous ammonium sulphate.
- D** It releases hydrogen with zinc powder.

0620_s/05/qp1

20 Hydrochloric acid is used to clean a metal surface by removing the oxide layer on the metal.

This is because hydrochloric acid has aX..... pH and the metal oxide isY.....

What are X and Y?

	X	Y
A	high	acidic
B	high	basic
C	low	acidic
D	low	basic

0620_s/05/qp1

21 The apparatus shown can be used to prepare aqueous copper(II) sulphate.

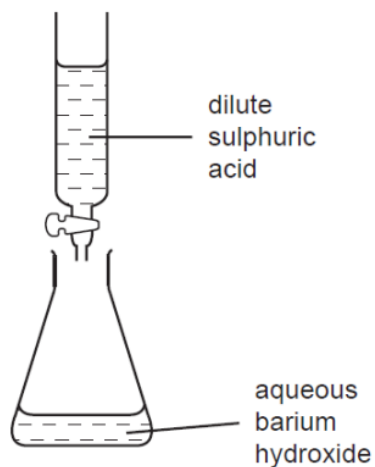


What are substances X and Y?

	substance X	substance Y
A	copper	iron(II) sulphate
B	copper(II) chloride	sulphuric acid
C	copper(II) oxide	sulphuric acid
D	sulphur	copper(II) chloride

0620_s/05/qp1

- 22 In the experiment shown, the dilute sulphuric acid is run into the flask of aqueous barium hydroxide until the reaction is complete.



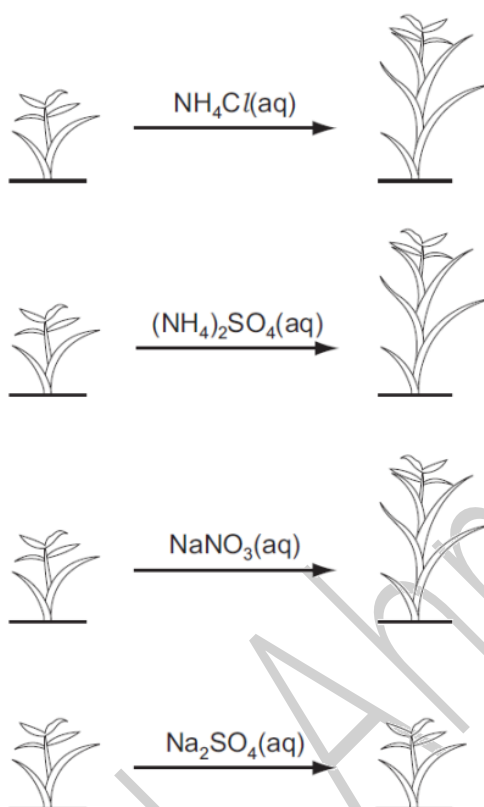
Which processes occur in this reaction?

	neutralisation	precipitation
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_s/05/qp1

34 The diagrams show the growth of four plants.

before treatment after treatment



Which element is acting as a fertiliser?

A Cl

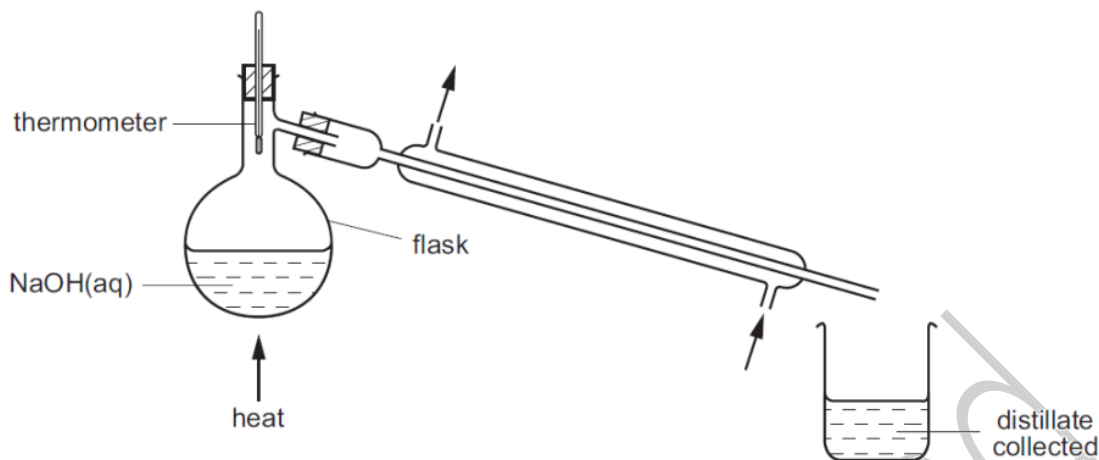
B N

C Na

D S

0620_s/04/qp1

30 The pH of some aqueous sodium hydroxide is measured. The solution is then distilled as shown.

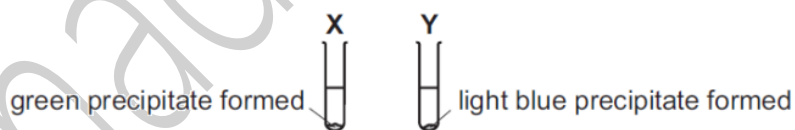


How do the pH values of the distillate and of the solution left in the flask compare with the original?

	pH of the distillate	pH of the solution left in the flask
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

0620_s/04/qp1

21 Aqueous sodium hydroxide is added to two different solutions with the results shown.



Which cation is present in **X** and in **Y**?

	X	Y
A	ammonium	iron(II)
B	copper(II)	ammonium
C	iron(II)	copper(II)
D	iron(II)	ammonium

0620_s/04/qp1

19 An aqueous solution contains either aluminium sulphate or zinc sulphate.

Which aqueous reagent can be used to confirm which salt is present?

- A ammonia
- B barium chloride
- C sodium hydroxide
- D sulphuric acid

0620_s/04/qp1

20 Compound X

- does not dissolve in water,
- does not react with water,
- is used to control soil acidity.

What is X?

- A calcium carbonate
- B calcium chloride
- C calcium hydroxide
- D calcium oxide

0620_s/04/qp1

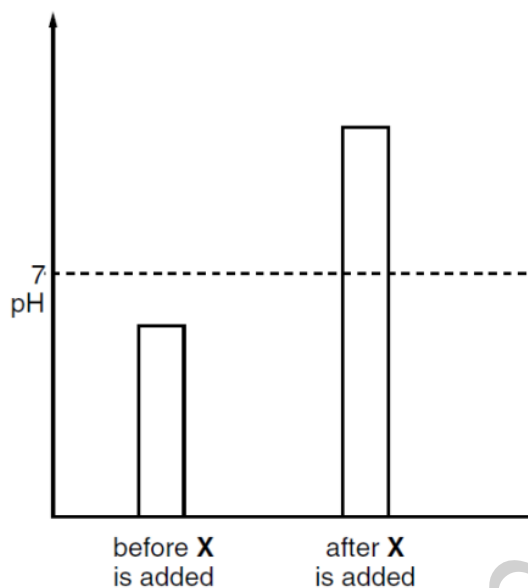
9 The oxide Pb_3O_4 reacts with dilute nitric acid to form lead(II) nitrate, lead(IV) oxide and another product.

What is the equation for this reaction?

- A $\text{Pb}_3\text{O}_4 + 4\text{HNO}_3 \rightarrow 2\text{Pb}(\text{NO}_3)_2 + \text{PbO}_2 + 2\text{H}_2\text{O}$
- B $\text{Pb}_3\text{O}_4 + 2\text{HNO}_3 \rightarrow 2\text{PbNO}_3 + \text{PbO}_4 + \text{H}_2$
- C $\text{Pb}_3\text{O}_4 + 4\text{HNO}_3 \rightarrow \text{Pb}(\text{NO}_3)_4 + 2\text{PbO} + 2\text{H}_2\text{O}$
- D $2\text{Pb}_3\text{O}_4 + 2\text{HNO}_3 \rightarrow 2\text{Pb}_2\text{NO}_3 + 2\text{PbO}_2 + \text{H}_2$

0620_s/04/qp1

35 The diagram shows how the pH of an industrial waste changes when substance X is added to it.



What is substance X?

- A coal
- B lime
- C salt
- D water

0620_s/03/qp1

34 A newspaper article claims that carbon dioxide is formed as follows.

- 1 during respiration
- 2 when calcium carbonate reacts with hydrochloric acid
- 3 when methane burns in air

Which statements are correct?

- A 1, 2 and 3
- B 1 and 2 only
- C 1 and 3 only
- D 2 and 3 only

0620_s/03/qp1

- 33 A student heats a mixture of ammonium chloride and calcium hydroxide. She tests the gas given off with damp red litmus paper.

What is the name of the gas and the final colour of the litmus paper?

	gas	colour
A	ammonia	blue
B	ammonia	red
C	chlorine	red
D	chlorine	white

0620_s/03/qp1

- 20 Which test method and gas are correctly linked?

	test method	gas
A	a lighted splint	oxygen
B	a glowing splint	hydrogen
C	damp litmus paper	chlorine
D	limewater	ammonia

0620_s/03/qp1

- 21 Water is added to a test-tube containing dilute sulphuric acid of pH 4.

What could be the pH of the resulting solution?

- A 8 B 6 C 4 D 2

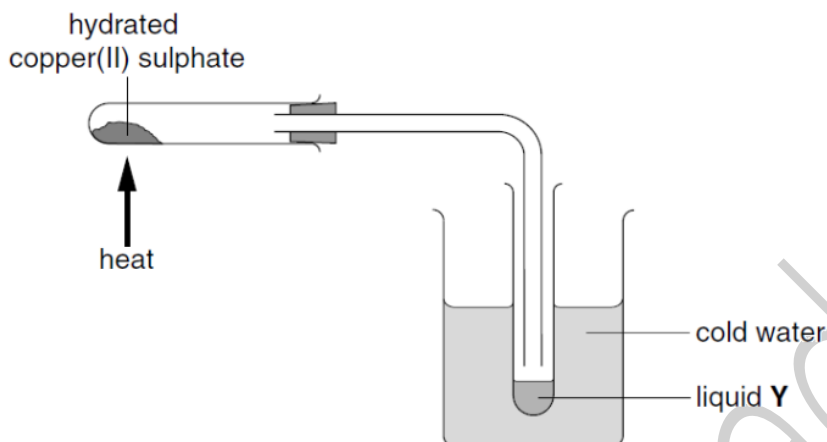
0620_s/03/qp1

- 19 Which substance does **not** form copper(II) sulphate with warm, dilute sulphuric acid?

- A copper
B copper(II) carbonate
C copper(II) hydroxide
D copper(II) oxide

0620_s/03/qp1

- 16 When hydrated copper(II) sulphate is heated in the apparatus shown, solid **X** and liquid **Y** produced.



Which changes are noticed when liquid **Y** is added to cold solid **X**?

	colour change	heat change
A	blue to white	heat given out
B	blue to white	heat taken in
C	white to blue	heat given out
D	white to blue	heat taken in

0620_s/03/qp1

- 34 To grow roses, a fertiliser containing nitrogen, phosphorus and potassium is needed. For a good yield, the fertiliser should contain a high proportion of potassium.

Which fertiliser is best for roses?

fertiliser	proportion by mass		
	N	P	K
A	29	5	0
B	29	15	5
C	13	13	20
D	9	0	25

0620_w/07/qp1

- 21 Two tests are carried out on a solution containing both copper(II) sulphate and sodium chloride. A student records results as shown.

test	reagent	result
1	aqueous barium chloride	blue precipitate
2	aqueous silver nitrate	white precipitate

Which results are correctly recorded?

	1	2
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_w/07/qp1

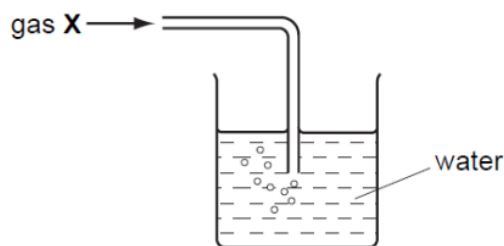
- 22 Aqueous solution **S** is added to aqueous ammonium chloride. The mixture is heated. Ammonia gas is given off.

What could solution **S** contain?

- A aluminium
- B ammonium sulphate
- C sodium chloride
- D sodium hydroxide

0620_w/07/qp1

19 Gas X is passed into water as shown.



The pH of the water changes from 7 to 10.

What is gas X?

- A ammonia
- B carbon dioxide
- C nitrogen
- D sulphur dioxide

0620_w/07/qp1

18 Dilute sulphuric acid is added to a mixture of copper, magnesium and zinc in a beaker. The beaker is left for about 10 minutes and its contents are then filtered.

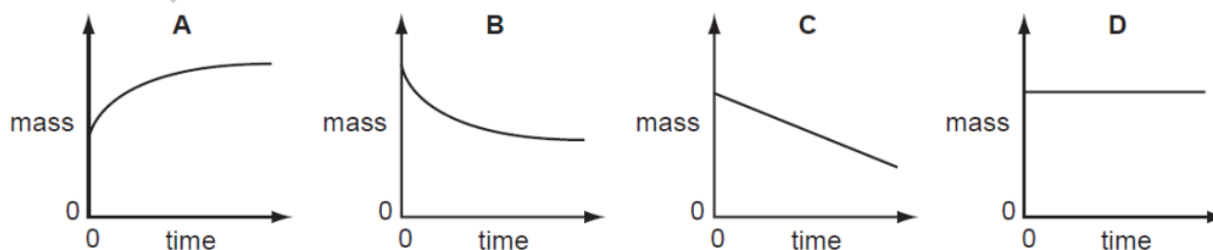
What does the filtrate contain?

- A copper(II) sulphate, magnesium sulphate and zinc sulphate
- B copper(II) sulphate and zinc sulphate only
- C magnesium sulphate and zinc sulphate only
- D magnesium sulphate only

0620_w/07/qp1

16 The mass of a beaker and its contents is plotted against time.

Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid in an open beaker?



0620_w/07/qp1

21 The statements are about metals and their oxides.

Metals ...X... electrons to form ions. The oxides of metals are ...Y....

Which words correctly complete the statements?

	X	Y
A	gain	acidic
B	gain	basic
C	lose	acidic
D	lose	basic

0620_w/06/qp1

17 Acids react with bases, carbonates and metals.

Which of these reactions produce a gas?

	reaction of acid with a		
	base	carbonate	metal
A	✓	✓	✓
B	✓	x	x
C	x	✓	✓
D	x	✓	x

0620_w/06/qp1

18 Which properties does an acid have?

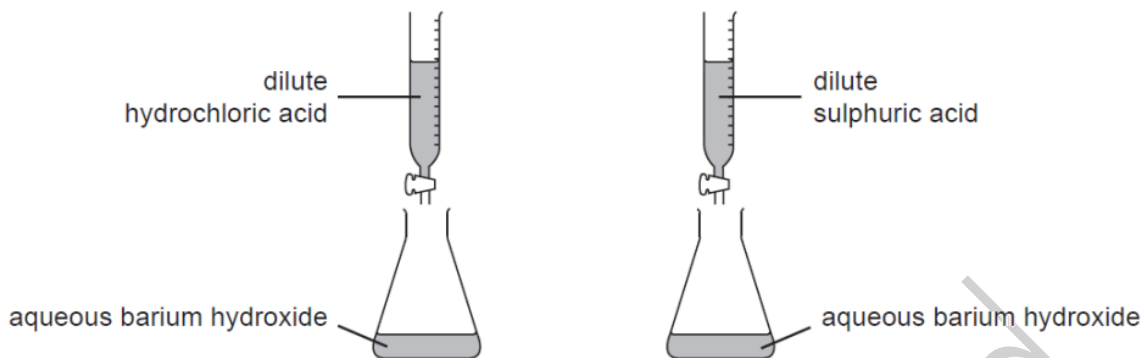
1 reacts with ammonium sulphate to form ammonia

2 turns red litmus blue

	1	2
A	✓	✓
B	✓	x
C	x	✓
D	x	x

0620_w/06/qp1

19 The diagrams show two experiments, one to make barium chloride and the other to make barium sulphate.



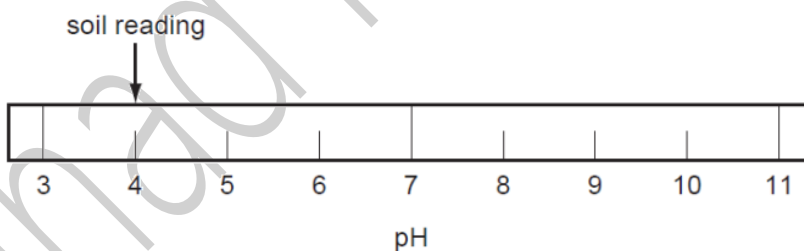
In each experiment, the acid is run into the conical flask until the resulting liquid has pH7.

What are the next steps to obtain samples of the solid salts?

	barium chloride	barium sulphate
A	crystallisation	crystallisation
B	crystallisation	filtration
C	filtration	crystallisation
D	filtration	filtration

0620_w/06/qp1

33 The diagram shows the results of a pH test on a sample of garden soil.

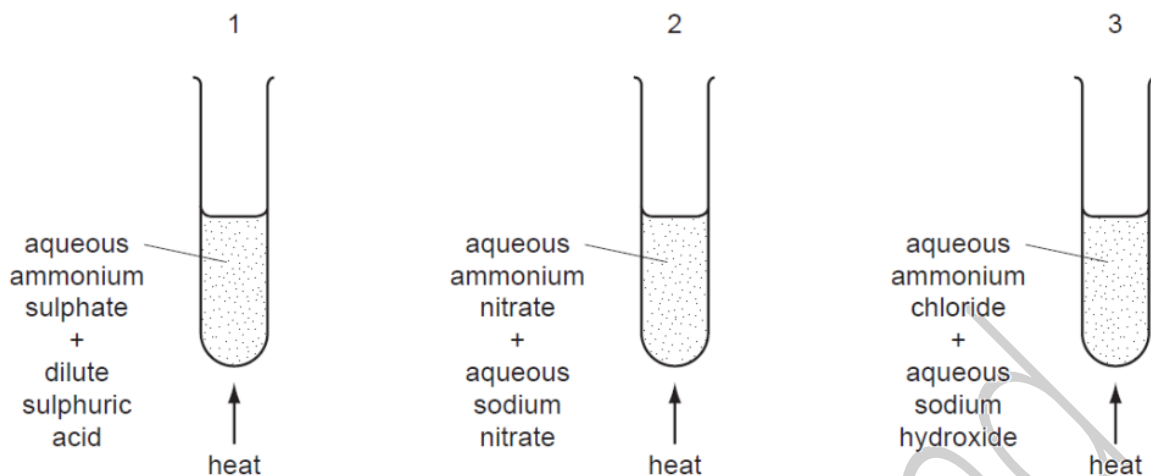


What could be added to the soil to change its pH to 7?

- A** ammonium nitrate
- B** lime
- C** sand
- D** sodium chloride

0620_w/05/qp1

31 The diagrams show three experiments.



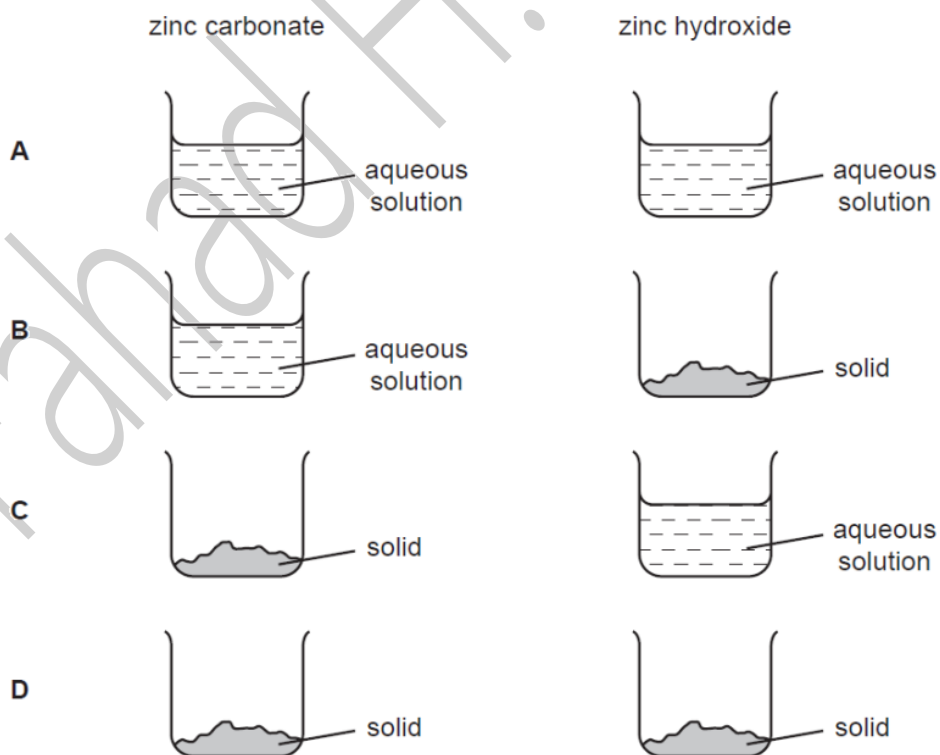
In which experiments is ammonia formed?

- A 1 only B 2 only C 3 only D 1, 2 and 3

0620_w/05/qp1

19 Pure zinc sulphate can be prepared by adding an excess of either zinc carbonate or an excess of zinc hydroxide to dilute sulphuric acid.

In which form are these zinc compounds used?



0620_w/05/qp1

- 20 Which aqueous ion causes a yellow precipitate to form when acidified aqueous lead(II) nitrate is added to it?
- A chloride
 - B iodide
 - C nitrate
 - D sulphate

0620_w/05/qp1

- 16 An excess of acid in the stomach causes indigestion that can be cured by an anti-indigestion tablet.

What should the tablet contain to decrease the acidity?

- A an acidic substance
- B an alkaline substance
- C a neutral substance
- D Universal Indicator

0620_w/05/qp1

- 17 A solution is made by adding sodium oxide to water.

Which pH change can occur?

	pH change		
A	1	→	7
B	7	→	1
C	7	→	12
D	12	→	7

0620_w/05/qp1

- 18 Which element has an oxide that forms a salt with an alkali?

- A N
- B Na
- C Ne
- D Ni

0620_w/05/qp1

7 Bottles of sodium hydroxide, sodium chloride and sugar have lost their labels.

Students test a sample from each bottle. Their results are shown in the table.

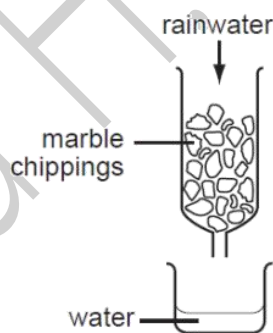
bottle	addition of water	conductivity of solution
1	forms an alkaline solution	conducts electricity
2	forms a neutral solution	conducts electricity
3	forms a neutral solution	does not conduct electricity

What are the correct labels for each bottle?

	bottle 1	bottle 2	bottle 3
A	sodium hydroxide	sodium chloride	sugar
B	sodium hydroxide	sugar	sodium chloride
C	sodium chloride	sugar	sodium hydroxide
D	sugar	sodium hydroxide	sodium chloride

0620_w/05/qp1

34 A sample of acid rainwater (pH = 4) is passed down a glass column packed with marble chippings (calcium carbonate). The water coming from the bottom of the column is collected in a beaker. The pH is now 6.



What causes the change in pH?

- A The acid has been filtered.
- B The acid has been neutralised.
- C The acid is made more concentrated.
- D The acid is precipitated.

0620_w/04/qp1

29 What is used to test for the presence of water?

- A anhydrous copper(II) sulphate
- B aqueous barium chloride
- C aqueous sodium hydroxide
- D Universal indicator paper

0620_w/04/qp1

19 Aqueous ammonia is added to a solution of a metal sulphate.

A green precipitate that is insoluble in excess of the aqueous ammonia forms.

Which metal ion is present?

- A Ca^{2+}
- B Cu^{2+}
- C Fe^{3+}
- D Fe^{2+}

0620_w/04/qp1

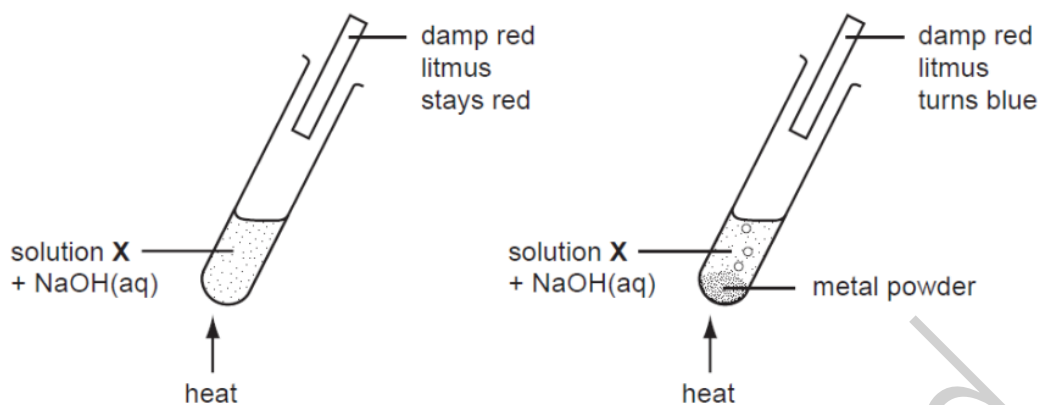
20 The chart shows the colour ranges of four different indicators.

Which indicator is blue in an acidic solution?

indicator	pH value															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
A	yellow		→ ←										blue			
B	red		→ ←										blue ← yellow			
C	red		→ ←										blue			
D	colourless										→ ←				blue	

0620_w/04/qp1

21 An ion X in solution is identified as shown.



What is ion X?

- A $Al^{3+}(aq)$ B $NH_4^+(aq)$ C $NO_3^-(aq)$ D $SO_4^{2-}(aq)$

0620_w/04/qp1

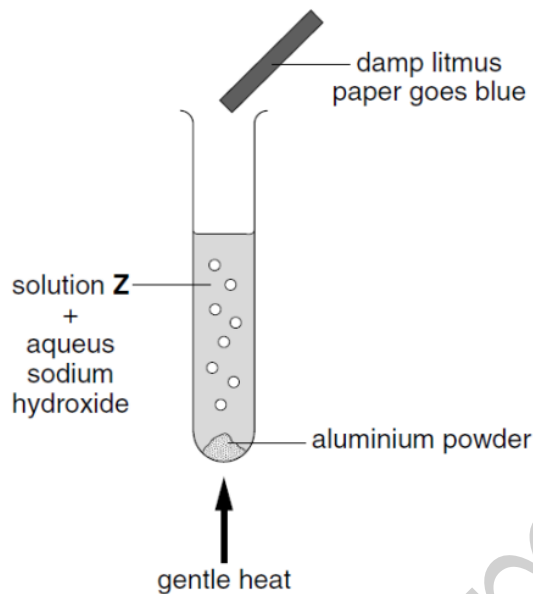
33 An NPK fertiliser contains three elements required for plant growth.

Which two compounds, when mixed, provide the three elements?

- A ammonium phosphate + potassium nitrate
B ammonium sulphate + potassium nitrate
C ammonium sulphate + sodium nitrate
D sodium phosphate + potassium chloride

0620_w/03/qp1

20 The diagram shows the result of testing an aqueous solution Z.

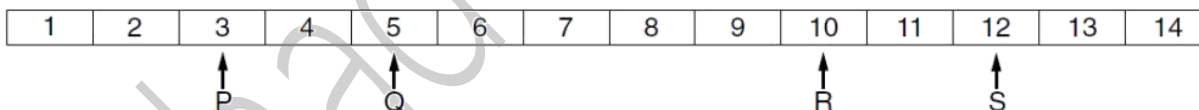


Which ion is present in solution Z?

- A carbonate
- B chloride
- C nitrate
- D sulphate

0620_w/03/qp1

21 The pH values of four solutions are shown.



Mixing combinations of these solutions can give a solution of pH 6.

Which combination of solutions could **not** do this?

- A P and R
- B P and S
- C Q and R
- D R and S

0620_w/03/qp1

19 Which two processes are involved in the preparation of magnesium sulphate crystals from dilute sulphuric acid and an excess of magnesium oxide?

- A decomposition and filtration
- B decomposition and oxidation
- C neutralisation and filtration
- D neutralisation and oxidation

0620_w/03/qp1

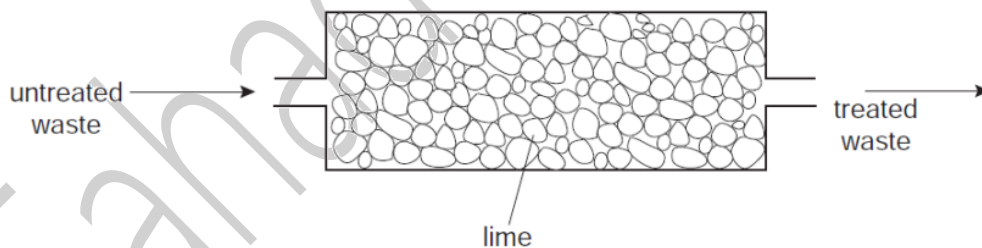
15 Potassium nitrate is a salt and dissolves in water in an endothermic process.

What happens to the temperature and pH of the water as the salt dissolves?

	temperature increases	pH falls
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_w/03/qp1

35 Lime is used to treat an industrial waste.



Which pH change occurs in the treatment?

- | | <u>untreated waste</u> | → | <u>treated waste</u> |
|---|------------------------|---|----------------------|
| A | acidic | → | neutral |
| B | alkaline | → | acidic |
| C | alkaline | → | neutral |
| D | neutral | → | acidic |

0620_w/02/qp1

33 Which two other compounds should be added to ammonium sulphate to make a complete NPK fertiliser?

- A KNO_3 , Na_2HPO_4
- B K_2SO_4 , KNO_3
- C NaCl , $\text{Ca}_3(\text{PO}_4)_2$
- D NH_4Cl , Na_2HPO_4

0620_w/02/qp1

20 Which element reacts with dilute sulphuric acid to produce hydrogen?

- A carbon
- B chlorine
- C copper
- D zinc

0620_w/02/qp1

21 For which pH change is there the largest increase in acidity?

	initial pH	final pH
A	1	3
B	2	6
C	3	1
D	6	2

0620_w/02/qp1

19 Aqueous lead(II) nitrate is added to a solution containing iodide ions. Lead(II) iodide is formed.

Which type of reaction takes place?

- A neutralisation
- B oxidation
- C precipitation
- D reduction

0620_w/02/qp1

- 9 One method of producing carbon dioxide is to react calcium carbonate with dilute hydrochloric acid.

What is the balanced chemical equation for the reaction?

- A $\text{CaCO}_3 + \text{HCl} \rightarrow \text{CaO} + \text{CO}_2 + \text{HCl}$
 B $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
 C $\text{CaCO}_3 + 4\text{HCl} \rightarrow \text{CaCl}_4 + \text{CO}_2 + \text{H}_2 + \text{H}_2\text{O}$
 D $\text{Ca}(\text{HCO}_3)_2 + \text{HCl} \rightarrow \text{CaCl} + 2\text{CO}_2 + \text{H}_2\text{O}$

0620_w/02/qp1

- 32 Which compound would **not** be an effective fertiliser?

- A ammonium nitrate, NH_4NO_3
 B calcium oxide, CaO
 C calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$
 D potassium nitrate, KNO_3

0620_s/14/qp12

- 20 Copper carbonate reacts with dilute sulfuric acid to make copper sulfate.



Which row gives the correct order of steps for making copper sulfate crystals?

	step 1	step 2	step 3	step 4
A	add excess acid to the copper carbonate	filter	evaporate filtrate to point of crystallisation	leave to cool
B	add excess acid to the copper carbonate	filter	evaporate to dryness	leave to cool
C	add excess copper carbonate to the acid	evaporate to point of crystallisation	leave to cool	filter
D	add excess copper carbonate to the acid	filter	evaporate filtrate to point of crystallisation	leave to cool

0620_s/14/qp11

19 Element X forms an oxide, XO, that neutralises sulfuric acid.

Which row describes X and XO?

	element X	nature of oxide, XO
A	metal	acidic
B	metal	basic
C	non-metal	acidic
D	non-metal	basic

0620_s/14/qp12

17 Different plants grow best under different pH conditions.

Which plant grows best in alkaline soil?

	plant	grows best in soil at pH
A	cabbage	6-8
B	potato	4-7
C	strawberry	5-7
D	wheat	6-7

0620_s/14/qp12

32 Which compound contains two of the three essential elements needed for a complete fertiliser?

- A** ammonium chloride
- B** ammonium nitrate
- C** ammonium phosphate
- D** ammonium sulfate

0620_s/14/qp11

21 Which acid reacts with ammonia to produce the salt ammonium sulfate?

- A hydrochloric
- B nitric
- C phosphoric
- D sulfuric

0620_s/14/qp11

22 Aqueous sodium hydroxide is added to solid X and the mixture is heated.

A green precipitate is formed and an alkaline gas is given off.

Which ions are present in X?

- A NH_4^+ and Fe^{2+}
- B NH_4^+ and Fe^{3+}
- C OH^- and Fe^{2+}
- D OH^- and Fe^{3+}

0620_s/14/qp11

20 Only two elements are liquid at 20 °C. One of these elements is shiny and conducts electricity.

This suggests that this element is a1..... and therefore its oxide is2..... .

Which words correctly complete gaps 1 and 2?

	1	2
A	metal	acidic
B	metal	basic
C	non-metal	acidic
D	non-metal	basic

0620_s/14/qp11

19 Which statements about alkalis are correct?

- 1 When reacted with an acid, the pH of the alkali increases.
- 2 When tested with litmus, the litmus turns blue.
- 3 When warmed with an ammonium salt, ammonia gas is given off.

- A 1, 2 and 3
- B 1 and 2 only
- C 1 and 3 only
- D 2 and 3 only

0620_s/14/qp11

9 A compound contains one atom of calcium, two atoms of hydrogen and two atoms of oxygen.
What is the correct chemical formula of the compound?

- A CaO_2H_2 B HOCaOH C H_2CaO_2 D $\text{Ca}(\text{OH})_2$

0620_s/14/qp11

33 Nitrogen, phosphorus and potassium are essential elements for plant growth.

Which mixture provides all three essential elements?

	mixture	formula
A	ammonium phosphate + potassium chloride	$(\text{NH}_4)_3\text{PO}_4$ + KCl
B	ammonium phosphate + ammonium nitrate	$(\text{NH}_4)_3\text{PO}_4$ + NH_4NO_3
C	ammonium phosphate + ammonium chloride	$(\text{NH}_4)_3\text{PO}_4$ + NH_4Cl
D	ammonium nitrate + potassium chloride	NH_4NO_3 + KCl

0620_s/13/qp11

19 The diagram shows one period of the Periodic Table.

Li	Be	B	C	N	O	F	Ne
----	----	---	---	---	---	---	----

Which two elements form acidic oxides?

- A carbon and lithium
B carbon and neon
C carbon and nitrogen
D nitrogen and neon

0620_s/13/qp11

18 Ant stings hurt because of the methanoic acid produced by the ant.

Which substance could, **most safely**, be used to neutralise the acid?

	substance	pH
A	baking soda	8
B	car battery acid	1
C	lemon juice	3
D	oven cleaner	14

0620_s/13/qp11

33 Which substance would make the best general fertiliser?

	relative amount			solubility in water
	P	K	N	
A	5	0	5	soluble
B	5	5	20	insoluble
C	5	10	15	soluble
D	10	5	10	insoluble

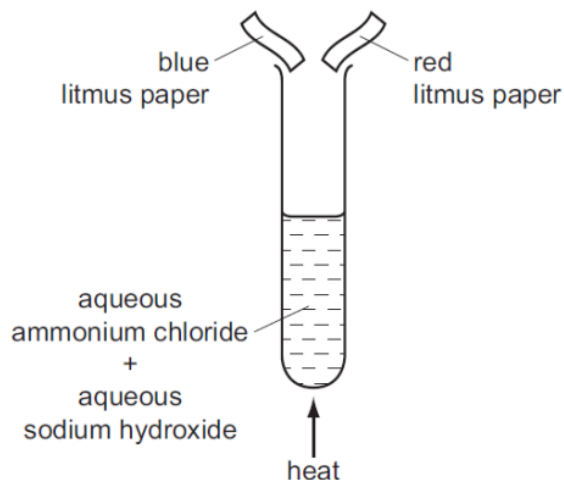
0620_s/13/qp12

19 Which statement about the reaction of acids is correct?

- A** They react with ammonium salts to form a salt and ammonia only.
- B** They react with metal carbonates to give a salt and carbon dioxide only.
- C** They react with metal hydroxides to give a salt and water only.
- D** They react with metals to give a salt, hydrogen and water only.

0620_s/13/qp12

20 The diagram shows an experiment.



What happens to the pieces of litmus paper?

	blue litmus paper	red litmus paper
A	changes colour	changes colour
B	changes colour	no colour change
C	no colour change	changes colour
D	no colour change	no colour change

0620_s/13/qp12

21 Two indicators, bromophenol blue and Congo red, show the following colours in acidic solutions and in alkaline solutions.

indicator	acid	alkali
bromophenol blue	yellow	blue
Congo red	violet	red

A few drops of each indicator are added to separate samples of a solution of pH 2.

What are the colours of the indicators in this solution?

	in a solution of pH 2	
	bromophenol blue is	Congo red is
A	blue	red
B	blue	violet
C	yellow	red
D	yellow	violet

0620_s/13/qp12

16 Two oxides, X and Y, are added separately to dilute sulfuric acid and dilute sodium hydroxide.

X reacts with dilute sulfuric acid but Y does not react.

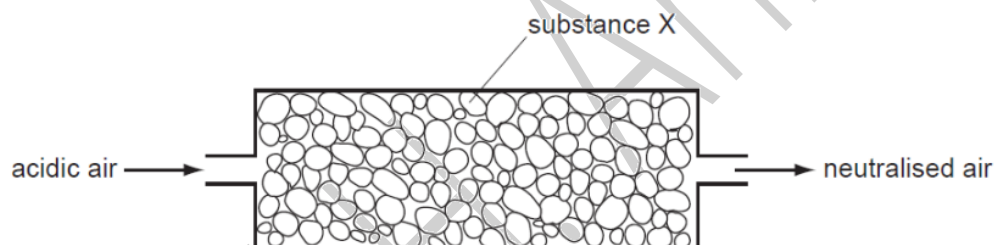
Y reacts with aqueous sodium hydroxide but X does not react.

Which type of oxide are X and Y?

	acidic oxide	basic oxide	metallic oxide
A	X	Y	X
B	X	Y	Y
C	Y	X	X
D	Y	X	Y

0620_s/13/qp12

33 Air containing an acidic impurity was neutralised by passing it through a column containing substance X.



What is substance X?

- A** calcium oxide
- B** sand
- C** sodium chloride
- D** concentrated sulfuric acid

0620_s/12/qp11

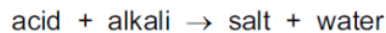
30 Fertilisers need to supply crops with three main elements.

Which compound contains all three of these elements?

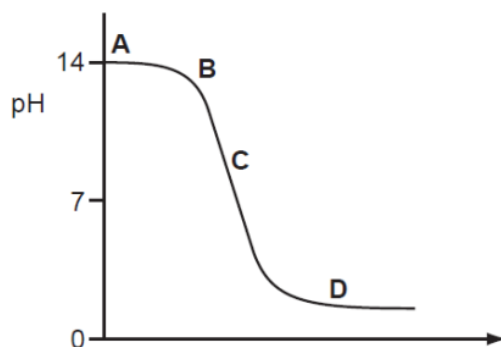
- A** H_3PO_4
- B** KNO_3
- C** $\text{NH}_4\text{K}_2\text{PO}_4$
- D** NH_4NO_3

0620_s/12/qp11

17 The graph shows how the pH changes as an acid is added to an alkali.



Which letter represents the area of the graph where both acid and salt are present?



0620_s/12/qp11

18 Dilute hydrochloric acid is added to a solid, S.

A flammable gas, G, is formed. Gas G is less dense than air.

What are S and G?

	solid S	gas G
A	copper	hydrogen
B	copper carbonate	carbon dioxide
C	zinc	hydrogen
D	zinc carbonate	carbon dioxide

0620_s/12/qp11

THEORY: Acids, Bases & Salts (iGCSE)

8 (a) Describe how cobalt chloride paper can be used to test for the presence of water.

.....
..... [2]

(b) Complete the description of the preparation of crystals of the soluble salt, cobalt(II) chloride-6-water, $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$, from the insoluble base, cobalt(II) carbonate.



50 cm³ of dilute hydrochloric acid, concentration 2.2 mol/dm³, was heated and cobalt(II) carbonate was added in small amounts until

.....
.....
.....
.....
..... [4]

0620/w14/qp33

6 Rubidium and strontium are very reactive metals at the top of the reactivity series. Because their ions have different charges, their compounds behave differently when heated.

(a) The formulae of the ions of these two elements are Rb^+ and Sr^{2+} .
Explain why these metals, which are in different groups, form ions which have different charges.

.....
..... [2]

(b) Strontium carbonate is similar to calcium carbonate. It is insoluble in water and it decomposes when heated. Rubidium carbonate is soluble in water and does not decompose when heated.

(i) Describe a method to prepare a pure sample of the insoluble salt, strontium carbonate, by precipitation.

.....
.....
.....
.....
..... [4]

0620/w14/qp33

(c) When a mixture of sulfur and potassium nitrate is burned and the products are dissolved in water, sulfuric acid is formed.

(i) The sulfuric acid formed by this method is not pure. It contains another acid.
Deduce the identity of this acid.

..... [1]

(ii) The heat causes some of the potassium nitrate to decompose.
Write the equation for the action of heat on potassium nitrate.

..... [2]

0620/w14/qp32

1 (a) Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

solution	pH
aqueous ammonia, a weak base
dilute hydrochloric acid, a strong acid
aqueous sodium hydroxide, a strong base
aqueous sodium chloride, a salt
dilute ethanoic acid, a weak acid

[5]

(b) Explain why solutions of hydrochloric acid and ethanoic acid with the same concentration, in mol/dm³, have a different pH.

.....

.....

..... [2]

(c) Measuring pH is one way of distinguishing between a strong acid and a weak acid. Describe another method.

method

.....

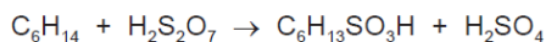
results

..... [2]

[Total: 9]

0620/w14/qp31

(a) Sulfonic acids are made from alkanes and oleum, H₂S₂O₇.



(b) The formula of the hexanesulfonate ion is $C_6H_{13}SO_3^-$.

The formula of the barium ion is Ba^{2+} . What is the formula of barium hexanesulfonate?

..... [1]

(c) Complete the following equations.

(i) magnesium + hexanesulfonic acid \rightarrow + [1]

(ii) calcium + hexanesulfonic oxide acid \rightarrow + [1]

(iii) $C_6H_{13}SO_3H$ + Na_2CO_3 \rightarrow + + [2]

(d) (i) Sulfuric acid is a strong acid.

You are given aqueous sulfuric acid, concentration 0.1 mol/dm^3 , and aqueous hexanesulfonic acid, concentration 0.2 mol/dm^3 . Describe how you could show that hexanesulfonic acid is also a strong acid.

..... [2]

(ii) Deduce why, for a fair comparison, the two acid solutions must have different concentrations.

..... [1]

(iii) Explain the terms *strong acid* and *weak acid*.

..... [2]

0620/w13/qp33

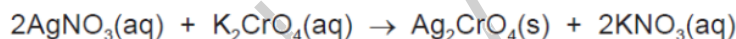
- (c) It is possible to determine whether zirconium(IV) oxide is acidic, neutral, basic or amphoteric using an acid and an alkali. Complete the table of possible results. If the oxide is predicted to react write 'R', if it is predicted not to react write 'NR'.

if the oxide is	predicted result with hydrochloric acid	predicted result with aqueous sodium hydroxide
acidic		
neutral		
basic		
amphoteric		

[4]

0620/w13/qp33

- 5 Silver(I) chromate(VI) is an insoluble salt. It is prepared by precipitation. 20 cm³ of aqueous silver(I) nitrate, concentration 0.2 mol/dm³, was mixed with 20 cm³ of aqueous potassium chromate(VI), concentration 0.1 mol/dm³. After stirring, the mixture was filtered. The precipitate was washed several times with distilled water. The precipitate was then left in a warm oven for several hours.



- (a) What difficulty arises if the name of a compound of a transition element does not include its oxidation state, for example iron oxide?

.....
 [2]

- (b) These questions refer to the preparation of the salt.

(i) Why is it necessary to filter the mixture after mixing and stirring?
 [1]

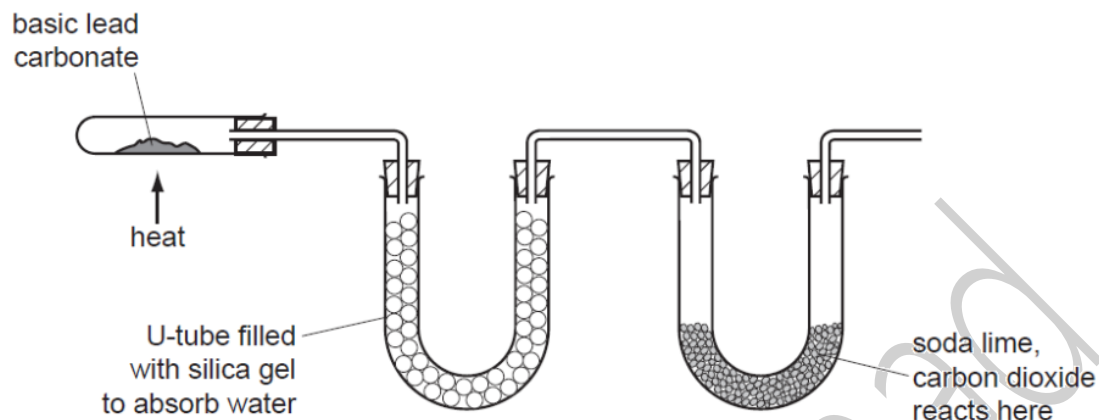
(ii) What is the purpose of washing the precipitate?
 [1]

(iii) Why leave the precipitate in a warm oven?
 [1]

(c) (i) Explain why the concentrations of silver(I) nitrate and potassium chromate(VI) are different.
 [1]

0620/w13/qp32

(b) Basic lead(II) carbonate is heated in the apparatus shown below. Water and carbon dioxide are produced.



(i) Silica gel absorbs water. Silica gel often contains anhydrous cobalt(II) chloride. When this absorbs water it changes from blue to pink. Suggest a reason.

..... [1]

(ii) Soda lime is a mixture of sodium hydroxide and calcium oxide. Why do these two substances react with carbon dioxide?

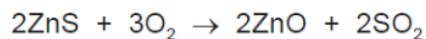
.....
 [2]

(iii) Name **two** substances formed when soda lime reacts with carbon dioxide.

..... [2]

0620/w13/qp31

- (b) Zinc metal is made by the reduction of zinc oxide. The major ore of zinc is zinc blende, ZnS. Zinc blende contains silver and lead compounds as well as zinc sulfide. Zinc blende is converted into impure zinc oxide by heating it in air.



- (i) Describe how zinc oxide is reduced to zinc.

..... [1]

- (ii) Some of the zinc oxide is dissolved in sulfuric acid to make aqueous zinc sulfate. Write a balanced symbol equation for this reaction.

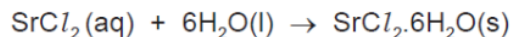
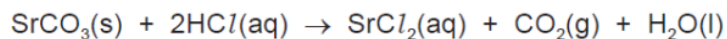
..... [2]

- (iii) This impure solution of zinc sulfate contains zinc ions, silver(I) ions and lead ions. Explain why the addition of zinc powder produces pure zinc sulfate solution. Include at least one ionic equation in your explanation.

.....
.....
.....
.....
.....
..... [4]

0620/w12/qp33

- (b) Strontium chloride-6-water can be made from the insoluble compound, strontium carbonate, by the following reactions.



The following method was used to prepare the crystals.

- 1 Add excess strontium carbonate to hot hydrochloric acid.
- 2 Filter the resulting mixture.
- 3 Partially evaporate the filtrate and allow to cool.
- 4 Filter off the crystals of $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$.
- 5 Dry the crystals between filter papers.

- (i) How would you know when excess strontium carbonate had been added in step 1?

.....
..... [1]

- (ii) Why is it necessary to filter the mixture in step 2?

..... [1]

- (iii) In step 3, why partially evaporate the filtrate rather than evaporate to dryness?

..... [1]

0620/w12/qp31

4 Silicon(IV) oxide, SiO_2 , and zirconium(IV) oxide, ZrO_2 , are both macromolecules. They have similar physical properties but silicon(IV) oxide is acidic and zirconium(IV) oxide is amphoteric.

(a) Define the term *macromolecule*.

.....
..... [1]

(b) (i) Predict **three** physical properties of these two oxides.

.....
.....
..... [3]

(ii) Name an element which has the same physical properties as these two oxides.

..... [1]

(c) (i) Name a reagent that reacts with the oxides of both elements.

..... [1]

(ii) Name a reagent that reacts with only one of the oxides.

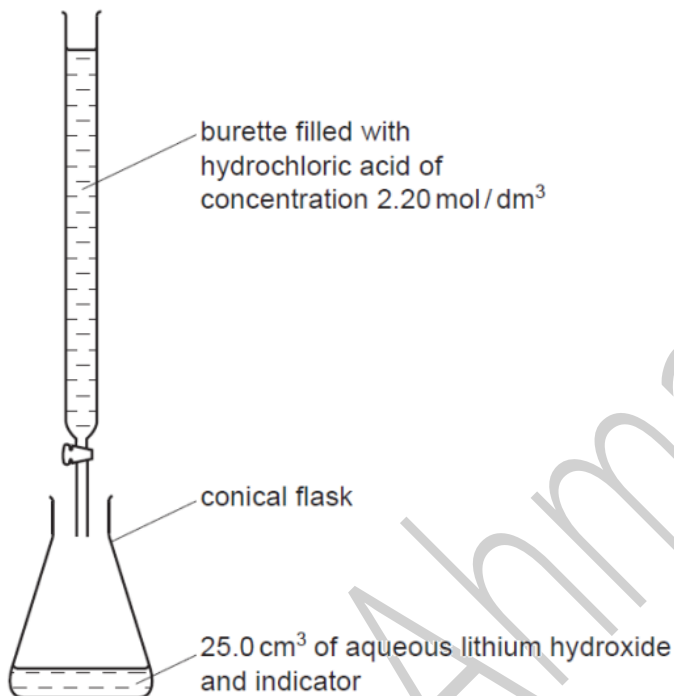
reagent

oxide which reacts [2]

0620/w12/qp31

7 The hydroxides of the Group I metals are soluble in water. Most other metal hydroxides are insoluble in water.

(a) (i) Crystals of lithium chloride can be prepared from lithium hydroxide by titration.



25.0 cm³ of aqueous lithium hydroxide is pipetted into the conical flask. A few drops of an indicator are added. Dilute hydrochloric acid is added slowly to the alkali until the indicator just changes colour. The volume of acid needed to neutralise the lithium hydroxide is noted.

A neutral solution of lithium chloride, which still contains the indicator, is left. Describe how you could obtain a neutral solution of lithium chloride which does **not** contain an indicator.

.....
 [2]

(ii) You cannot prepare a neutral solution of magnesium chloride by the same method. Describe how you could prepare a neutral solution of magnesium chloride.

.....

 [3]

0620/s13/qp31

6 Ammonia is a compound which only contains the elements nitrogen and hydrogen. It is a weak base.

(a) (i) Define the term *base*.

..... [1]

(ii) Given aqueous solutions of ammonia and sodium hydroxide, both having a concentration of 0.1 mol/dm^3 , how could you show that ammonia is the weaker base?

.....
.....
..... [2]

(e) Hydrazine is a weak base and it removes dissolved oxygen from water. It is added to water in steel boilers to prevent rusting.

(i) One way it reduces the rate of rusting is by changing the pH of water. What effect would hydrazine have on the pH of water?

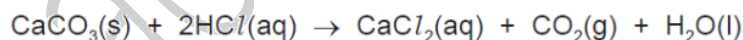
..... [1]

(ii) Give a reason, other than pH, why hydrazine reduces the rate of rusting.

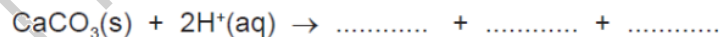
..... [1]

0620/s13/qp31

(b) The equation for the reaction in experiment 1 is:



Complete the following ionic equation.



[1]

0620/s13/qp31

(e) The hydroxide of **M** is a white powder which is insoluble in water. Describe how you could show that this hydroxide is amphoteric.

.....

 [2]

0620/s13/qp31

2 Three ways of making salts are

- titration using a soluble base or carbonate
- neutralisation using an insoluble base or carbonate
- precipitation.

(a) Complete the following table of salt preparations.

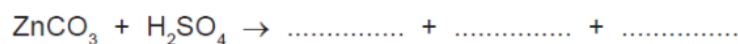
method	reagent 1	reagent 2	salt
titration	..... .....	..... .....	sodium nitrate
neutralisation	nitric acid	..... .....	copper(II) nitrate
precipitation	..... .....	..... .....	silver(I) chloride
neutralisation	sulfuric acid	zinc(II) carbonate	..........

[6]

(b) (i) Write an ionic equation with state symbols for the preparation of silver(I) chloride.

..... [2]

(ii) Complete the following equation.



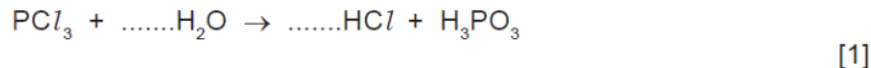
[2]

[Total: 10]

0620/s12/qp31

(b) Phosphorus trichloride reacts with water to form two acids.

(i) Balance the equation for this reaction.



(ii) Describe how you could show that phosphorus acid, H_3PO_3 , is a weaker acid than hydrochloric acid.

.....

 [3]

(iii) Two salts of phosphorus acid are its sodium salt, which is soluble in water, and its calcium salt which is insoluble in water. Suggest a method of preparation for each of these salts from aqueous phosphorus acid. Specify any other reagent needed and briefly outline the method.

sodium salt

.....

 [2]

calcium salt

.....

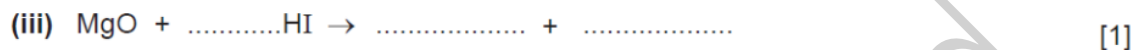
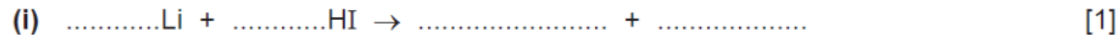
 [2]

[Total: 10]

0620/s11/qp32

5 Hydriodic acid, HI(aq), is a strong acid. Its salts are iodides.

(a) It has the reactions of a typical strong acid. Complete the following equations.

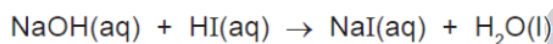
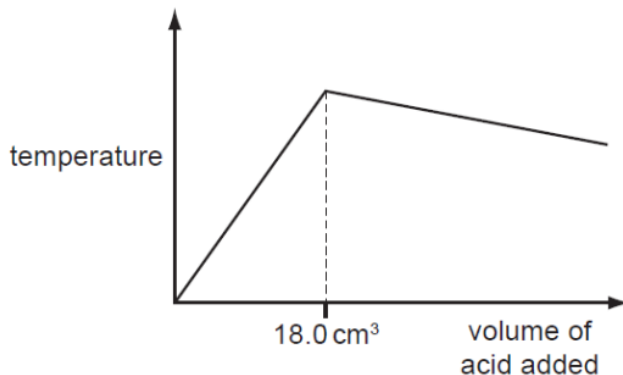


(b) Two of the reactions in (a) are acid/base and one is redox. Which one is redox? Explain your choice.

.....

 [2]

- (d) 20.0 cm³ of aqueous sodium hydroxide, 2.00 mol/dm³, was placed in a beaker. The temperature of the alkali was measured and 1.0 cm³ portions of hydriodic acid were added. After each addition, the temperature of the mixture was measured. Typical results are shown on the graph.



- (i) Explain why the temperature increases rapidly at first then stops increasing.

.....
 [2]

- (ii) Suggest why the temperature drops after the addition of 18.0 cm³ of acid.

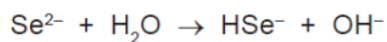
..... [1]

- (iii) In another experiment, it was shown that 15.0 cm³ of the acid neutralised 20.0 cm³ of aqueous sodium hydroxide, 1.00 mol/dm³. Calculate the concentration of the acid.

.....
 [2]

0620/s11/qp31

- (c) The selenide ion reacts with water.



What type of reagent is the selenide ion in this reaction? Give a reason for your choice.

.....
 [3]

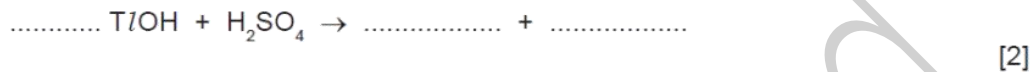
0620/s11/qp31

(d) Thallium(I) hydroxide is an alkali. It has similar properties to sodium hydroxide.

(i) Complete the following word equation.

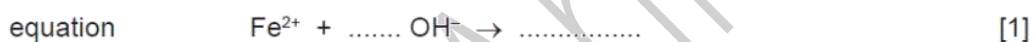


(ii) Complete the equation.



(iii) Aqueous thallium(I) hydroxide was added to aqueous iron(II) sulfate. Describe what you would see and complete the ionic equation for the reaction.

observation [1]



0620/s10/qp32

6 Thallium is a metal in Group III. It has oxidation states of +1 and +3.

(a) Give the formula for the following thallium compounds.

(i) thallium(I) sulfide [1]

(ii) thallium(III) chloride [1]

(b) Thallium(I) chloride is insoluble in water. Complete the description of the preparation of a pure sample of this salt.

Step 1

Mix a solution of sodium chloride with thallium(I) sulfate solution. A white precipitate forms.

Step 2

..... [1]

Step 3

..... [1]

Step 4

..... [1]

(c) When thallium(I) chloride is exposed to light, a photochemical reaction occurs. It changes from a white solid to a violet solid.

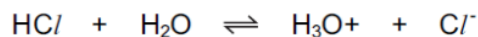
(i) Name another metal halide which changes colour when exposed to light. Give the major use of this metal halide.

name

use [2]

0620/s10/qp32

(b) They react with water to form acidic solutions.



(i) Explain why water behaves as a base in both of these reactions.

.....
..... [2]

(ii) At equilibrium, only 1% of the hydrogen chloride exists as molecules, the rest has formed ions. In the other equilibrium, 97% of the hydrogen fluoride exists as molecules, only 3% has formed ions.

What does this tell you about the strength of each acid?

.....
..... [2]

(iii) How would the pH of these two solutions differ?

..... [1]

[Total: 8]

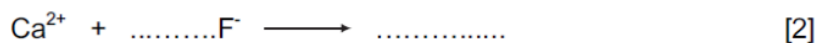
0620/s09/qp31

5 Insoluble salts are made by precipitation.

(a) A preparation of the insoluble salt calcium fluoride is described below.

To 15 cm³ of aqueous calcium chloride, 30 cm³ of aqueous sodium fluoride is added. The concentration of both solutions is 1.00 mol / dm³. The mixture is filtered and the precipitate washed with distilled water. Finally, the precipitate is heated in an oven.

(i) Complete the equation.



(ii) Why is the volume of sodium fluoride solution double that of the calcium chloride solution?

.....
 [1]

(iii) Why is the mixture washed with distilled water?

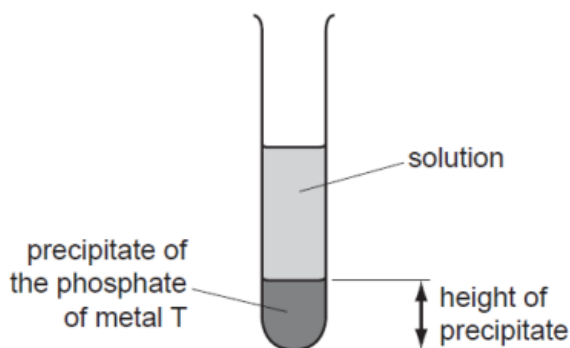
.....
 [1]

(iv) Why is the solid heated?

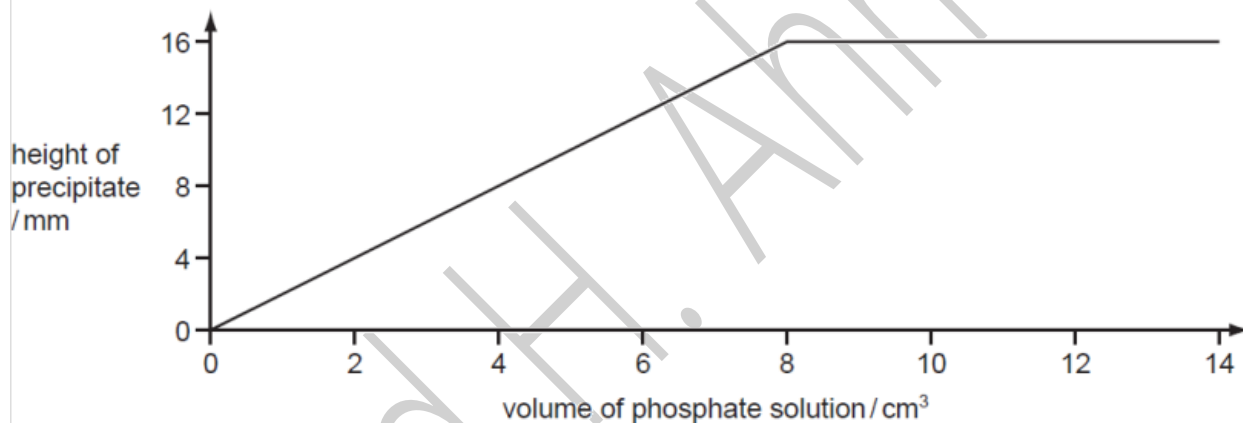
.....
 [1]

(b) The formulae of insoluble compounds can be found by precipitation reactions.

To 12.0 cm^3 of an aqueous solution of the nitrate of metal T was added 2.0 cm^3 of aqueous sodium phosphate, Na_3PO_4 . The concentration of both solutions was 1.00 mol/dm^3 . When the precipitate had settled, its height was measured.



The experiment was repeated using different volumes of the phosphate solution. The results are shown on the following graph.



What is the formula of the phosphate of metal T? Give your reasoning.

.....

.....

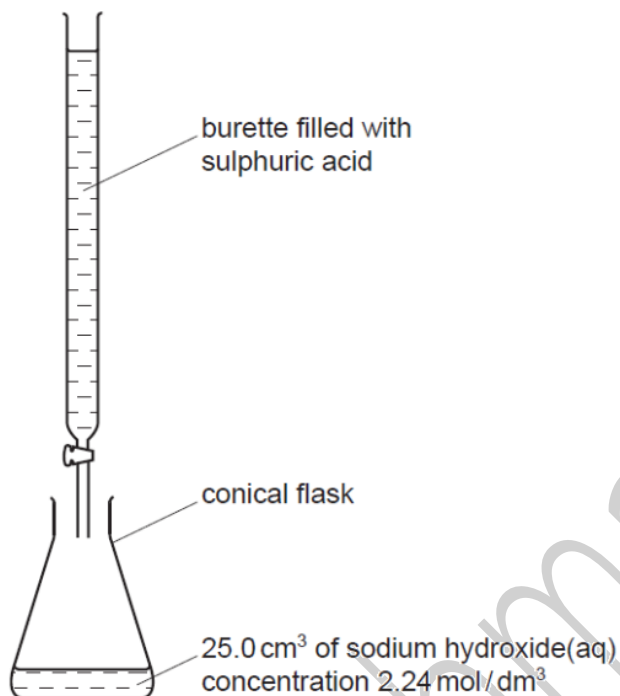
.....

..... [3]

[Total: 8]

0620/s09/qp31

7 Crystals of sodium sulphate-10-water, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, are prepared by titration.



- (a) 25.0 cm³ of aqueous sodium hydroxide is pipetted into a conical flask. A few drops of an indicator are added. Using a burette, dilute sulphuric acid is slowly added until the indicator just changes colour. The volume of acid needed to neutralise the alkali is noted.

Suggest how you would continue the experiment to obtain pure, dry crystals of sodium sulphate-10-water.

.....

.....

.....

.....

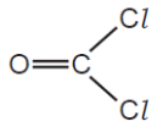
[4]

0620/s08/qp31

- (c) Carbonyl chloride reacts with water to form two acidic compounds.
Suggest which acidic compounds are formed.

1.
2. [2]

- (d) The structural formula of carbonyl chloride is given below.



Draw a diagram that shows the arrangement of the valency electrons in one molecule of this covalent compound.

Use x for an electron from a chlorine atom.

Use o for an electron from a carbon atom.

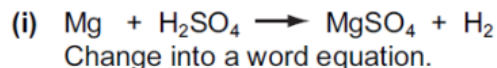
Use • for an electron from an oxygen atom.

[4]

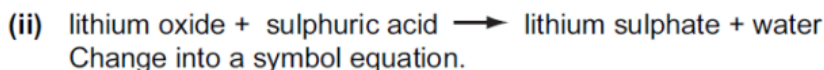
0620/s08/qp31

4 Sulphuric acid is a typical strong acid.

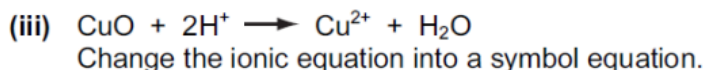
(a) Change the equations given into a different format.



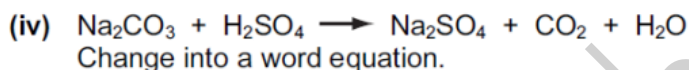
..... [1]



..... [2]

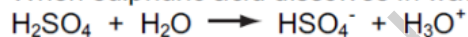


..... [2]



..... [1]

(b) When sulphuric acid dissolves in water, the following reaction occurs.



Explain why water is behaving as a base in this reaction.

..... [2]

(c) Sulphuric acid is a strong acid, ethanoic acid is a weak acid.
Explain the difference between a strong acid and a weak acid.

.....
..... [2]

[Total: 10]

0620/s08/qp31

3 There are three methods of preparing salts.

Method **A** – use a burette and an indicator.

Method **B** – mix two solutions and obtain the salt by precipitation.

Method **C** – add an excess of base or a metal to a dilute acid and remove the excess by filtration.

For each of the following salt preparations, choose one of the methods **A**, **B** or **C**, name any additional reagent needed and then write or complete the equation.

(i) the soluble salt, zinc sulphate, from the insoluble base, zinc oxide

method
 reagent
 word equation [3]

(ii) the soluble salt, potassium chloride, from the soluble base, potassium hydroxide

method
 reagent
 equation + → KCl + H₂O [3]

(iii) the insoluble salt, lead(II) iodide, from the soluble salt, lead(II) nitrate

method
 reagent
 equation Pb²⁺ + → [4]

[Total: 10]

0620/s07/qp3

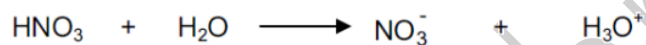
- 3 (a) Four bottles were known to contain aqueous ammonia, dilute hydrochloric acid, sodium hydroxide solution and vinegar, which is dilute ethanoic acid. The bottles had lost their labels. The pH values of the four solutions were 1, 4, 10 and 13.

Complete the table.

solution	pH
aqueous ammonia	
dilute hydrochloric acid	
sodium hydroxide solution	
vinegar	

[2]

- (c) When nitric acid is added to water the following reaction occurs.



Give the name and the formula of the particle which is transferred from nitric acid to water.

name

formula

[2]

(d) This question is concerned with the following oxides.

aluminium oxide	Al_2O_3
calcium oxide	CaO
carbon dioxide	CO_2
carbon monoxide	CO
magnesium oxide	MgO
sulphur dioxide	SO_2

(i) Which of the above oxides will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Which of the above oxides will react with aqueous sodium hydroxide but not with hydrochloric acid?

..... [1]

(iii) Which of the above oxides will react both with hydrochloric acid and with aqueous sodium hydroxide?

..... [1]

(iv) Which of the above oxides will react neither with hydrochloric acid nor with aqueous sodium hydroxide?

..... [1]

0620/s06/qp3

(c) Complete the following table by writing "reaction" or "no reaction" in the spaces provided.

oxide	type of oxide	reaction with acid	reaction with alkali
magnesium	basic	.....	.....
aluminium	amphoteric	.....	.....

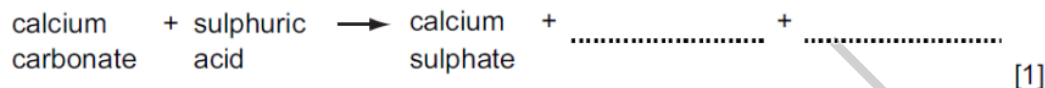
[2]

0620/s05/qp3

4 The Carlsbad caverns in New Mexico are very large underground caves. Although the walls of these caves are coated with gypsum (hydrated calcium sulphate), the caves have been formed in limestone.

(a) It is believed that the caves were formed by sulphuric acid reacting with the limestone.

(i) Complete the word equation.



(ii) Describe how you could test the water entering the cave to show that it contained sulphate ions.

test

result [2]

(iii) How could you show that the water entering the cave has a high concentration of hydrogen ions?

..... [1]

0620/s05/qp3

(b) To show that the polymer contains silver the following test was carried out.

The polymer fibres were chopped into small pieces and warmed with nitric acid. The silver atoms were oxidised to silver(I) ions. The mixture was filtered. Aqueous sodium chloride was added to the filtrate and a white precipitate formed.

(i) Why was the mixture filtered?

..... [1]

(ii) Explain why the change of silver atoms to silver ions is oxidation.

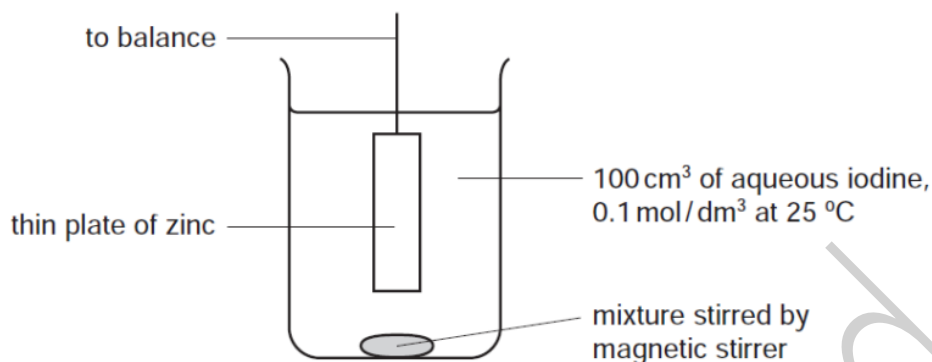
..... [1]

(iii) Give the name of the white precipitate.

..... [1]

0620/s05/qp3

- 2 The following apparatus was used to measure the rate of the reaction between zinc and iodine.



The mass of the zinc plate was measured every minute until the reaction was complete.

- (a) Write an ionic equation for the redox reaction that occurred between zinc atoms and iodine molecules.

..... [2]

- (b) Describe how you could show by adding aqueous sodium hydroxide and aqueous ammonia that a solution contained zinc ions.

result with sodium hydroxide

excess sodium hydroxide

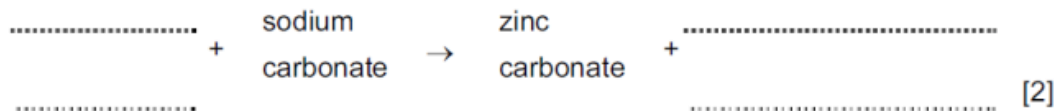
result with aqueous ammonia

excess aqueous ammonia [3]

0620/s05/qp3

4 (a) Insoluble compounds are made by precipitation.

(i) Complete the word equation for the preparation of zinc carbonate.



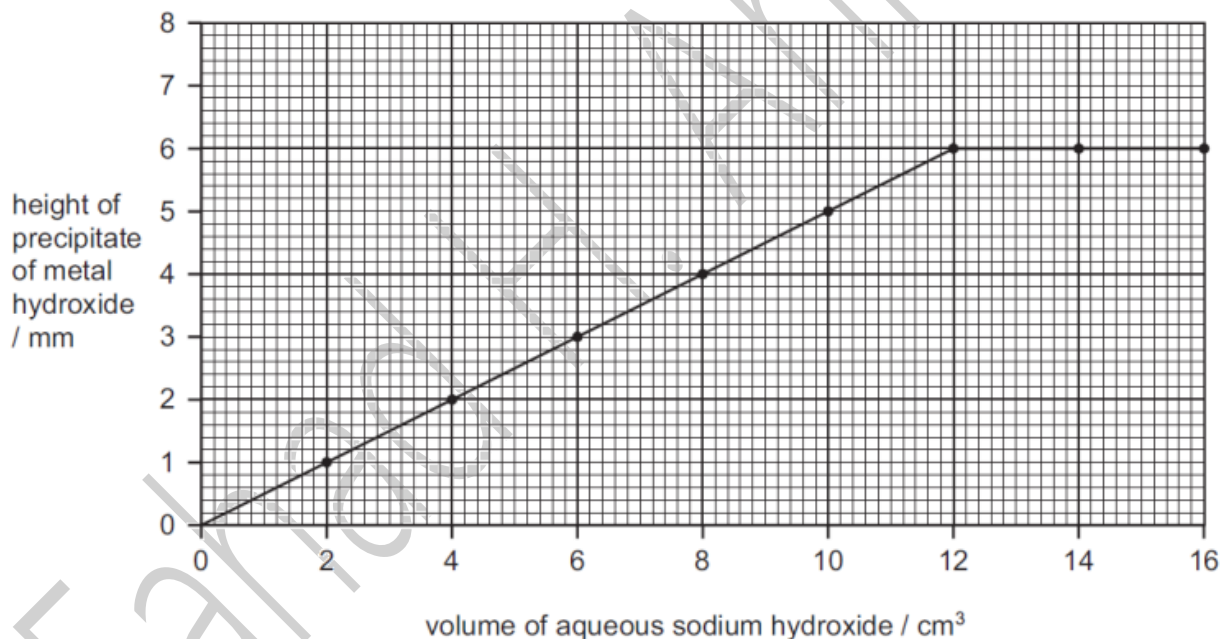
(ii) Complete the following symbol equation.



(iii) Write an ionic equation for the precipitation of the insoluble salt, silver(I) chloride.



(b) 2.0 cm³ portions of aqueous sodium hydroxide were added to 4.0 cm³ of aqueous iron(III) chloride. Both solutions had a concentration of 1.0 mol/dm³. After each addition, the mixture was stirred, centrifuged and the height of the precipitate of iron(III) hydroxide was measured. The results are shown on the following graph.



(i) Complete the ionic equation for the reaction.



(ii) On the same grid, sketch the graph that would have been obtained if iron(II) chloride had been used instead of iron(III) chloride? [2]

- (iii) If aluminium chloride had been used instead of iron(III) chloride, the shape of the graph would be different. How are the shapes of these two graphs different and why?

difference in shape

reason for difference

[2]

0620/s04/qp3

- (b) About one third of this production of acid is used to make nitrogen and phosphorus-containing fertilisers.

- (i) Name the third element that is essential for plant growth and is present in most fertilisers.

[1]

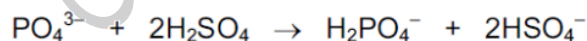
- (ii) Name a nitrogen-containing fertiliser that is manufactured from sulphuric acid.

[1]

- (iii) Rock phosphate (calcium phosphate) is obtained by mining. It reacts with concentrated sulphuric acid to form the fertiliser, superphosphate. Predict the formula of each of these phosphates.

fertiliser	ions	formula
calcium phosphate	Ca^{2+} and PO_4^{3-}	.....
calcium superphosphate	Ca^{2+} and H_2PO_4^-	..... [2]

- (iv) The ionic equation for the reaction between the phosphate ion and sulphuric acid is shown below.



Explain why the phosphate ion is described as acting as a base in this reaction.

[2]

0620/s04/qp3

(d) Nitrogen dioxide, oxygen and water react to form dilute nitric acid.
Describe how lead(II) nitrate crystals could be prepared from dilute nitric acid and lead(II) oxide.

.....
.....
.....[3]

0620/s03/qp3

(b) Describe the reactions, if any, of zinc and copper(II) ions with an excess of aqueous sodium hydroxide.

(i) zinc ions

addition of aqueous sodium hydroxide
.....
excess sodium hydroxide
.....

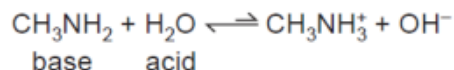
(ii) copper(II) ions

addition of aqueous sodium hydroxide
.....
excess sodium hydroxide
.....[4]

0620/s03/qp3

5 Methylamine, CH_3NH_2 , is a weak base. Its properties are similar to those of ammonia.

(a) When methylamine is dissolved in water, the following equilibrium is set up.



(i) Suggest why the arrows are not the same length.

..... [1]

(ii) Explain why water is stated to behave as an acid and methylamine as a base.

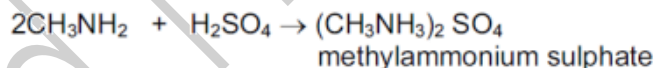
.....
..... [2]

(b) An aqueous solution of the strong base, sodium hydroxide, is pH 12. Predict the pH of an aqueous solution of methylamine which has the same concentration. Give a reason for your choice of pH.

.....
..... [2]

(c) Methylamine is a weak base like ammonia.

(i) Methylamine can neutralise acids.



Write the equation for the reaction between methylamine and hydrochloric acid.
Name the salt formed.

.....
..... [2]

(ii) When aqueous methylamine is added to aqueous iron(II) sulphate, a green precipitate is formed. What would you see if iron(III) chloride solution had been used instead of iron(II) sulphate?

..... [1]

(iii) Suggest the name of a reagent that will displace methylamine from one of its salts, for example methylammonium sulphate.

..... [1]

[Total: 9]

(c) Calcium carbonate is used to control soil acidity.

(i) Why is it important to control soil acidity?

..... [1]

(ii) Both calcium carbonate, insoluble in water, and calcium oxide, slightly soluble, are used to increase soil pH. Suggest **two** advantages of using calcium carbonate.

..... [2]

(iii) Give **one** use of calcium carbonate other than for making calcium oxide and controlling soil pH.

..... [1]

0620/w06/qp3

(b) In the above method, a soluble salt was prepared by neutralising an acid with an insoluble base. Other salts have to be made by different methods.

(i) Give a brief description of how the soluble salt, rubidium sulphate could be made from the soluble base, rubidium hydroxide.

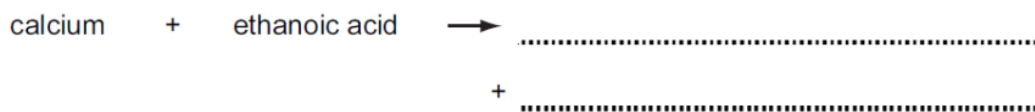
..... [3]

(ii) Suggest a method of making the insoluble salt, calcium fluoride.

..... [3]

0620/w05/qp3

(b) Complete the word equations for the reactions of ethanoic acid.



(c) Write the symbol equation for the reaction between ethanoic acid and sodium hydroxide.



0620/w05/qp3

2 The salt copper(II) sulphate can be prepared by reacting copper(II) oxide with sulphuric acid.

Complete the list of instructions for making copper(II) sulphate using **six** of the words below.

blue cool dilute filter
 saturated sulphate white oxide

Instructions

1 Add excess copper(II) oxide to sulphuric acid in a beaker and boil it.

2 to remove the unreacted copper(II) oxide.

3 Heat the solution until it is .

4 the solution to form

coloured crystals of copper (II) [6]

0620/w04/qp3

- 5 Sulphur dioxide, SO_2 , and sulphur trioxide, SO_3 , are the two oxides of sulphur.
- (a) Sulphur dioxide can kill bacteria and has bleaching properties. Give a use of sulphur dioxide that depends on each of these properties.
- (i) ability to kill bacteria[1]
- (ii) bleaching properties[1]

0620/w03/qp3

- (c) Ammonia is a base.
- (i) Name a particle that an ammonia molecule can accept from an acid.
.....
- (ii) Write an equation for ammonia acting as a base.
.....[3]
- (d) Given aqueous solutions, 0.1 mol/dm^3 , of sodium hydroxide and ammonia, describe how you could show that ammonia is the weaker base.
.....
.....[2]

0620/w03/qp3

- (b) It has several oxides, three of which are shown below.
Manganese(II) oxide, which is basic.
Manganese(III) oxide, which is amphoteric.
Manganese(IV) oxide, which is acidic.
- (i) Complete the word equation.
manganese(II) oxide + hydrochloric acid \rightarrow +
.....[2]
- (ii) Which, if any, of these oxides will react with sodium hydroxide?
.....[1]

0620/w02/qp3

- (b) There are three ways of making salts from sulphuric acid.
titration using a burette and indicator
precipitation by mixing the solutions and filtering
neutralisation of sulphuric acid using an excess of an insoluble base

Complete the following table of salt preparations.

method	reactant 1	reactant 2	salt
titration	sulphuric acid		sodium sulphate
neutralisation	sulphuric acid		zinc sulphate
precipitation	sulphuric acid		barium sulphate
	sulphuric acid	copper(II) oxide	copper(II) sulphate

[4]

- (c) The results of an investigation into the action of heat on copper(II) sulphate-5-water, a blue crystalline solid, are given below.

The formula is $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and the mass of one mole is 250 g

A 5.0 g sample of the blue crystals is heated to form 3.2 g of a white powder. With further heating this decomposes into a black powder and sulphur trioxide.

- (i) Name the white powder.

.....[1]

- (ii) What is observed when water is added to the white powder?

.....[1]

- (iii) Name the black powder.

.....[1]

- (iv) Calculate the mass of the black powder. Show your working.

.....

[3]

0620/w02/qp3

8 Methanoic acid is the first member of the homologous series of carboxylic acids.

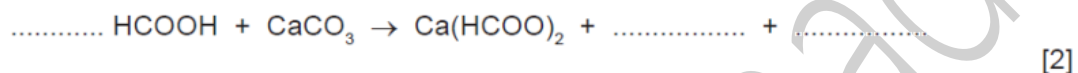
(a) Give **two** general characteristics of a homologous series.

.....

 [2]

(b) In some areas when water is boiled, the inside of kettles become coated with a layer of calcium carbonate. This can be removed by adding methanoic acid.

(i) Complete the equation.



(ii) Methanoic acid reacts with most metals above hydrogen in the reactivity series. Complete the word equation.

zinc + methanoic acid \rightarrow + [2]

(iii) Aluminium is also above hydrogen in the reactivity series. Why does methanoic acid not react with an aluminium kettle?

.....
 [1]

(c) Give the name, molecular formula and empirical formula of the fourth acid in this series.

name [1]

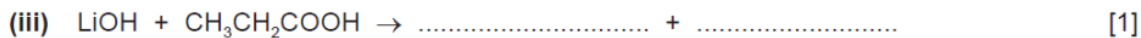
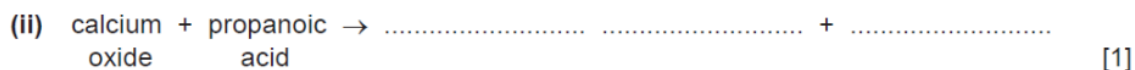
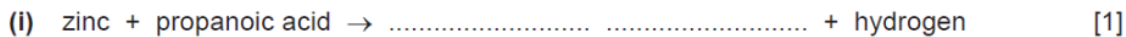
molecular formula [1]

empirical formula [1]

[Total: 10]

0620/s10/qp31

(c) Complete the following equations for some of the reactions of propanoic acid.
The salts of this acid are called propanoates.



0620/s14/qp32

(ii) Fertilisers contain nitrogen.
Name the other **two** elements essential for plant growth commonly found in fertilisers.

..... [2]

(b) Crops do not grow well if the soil is too acidic.

(i) One cause of acidity in soil is acid rain. Explain how acid rain is formed.

.....

 [3]

(ii) Name **two** bases which are used to increase the pH of acidic soils.

..... [2]

0620/s14/qp32

(b) (i) Suggest why a solution of malonic acid, concentration 0.2 mol/dm^3 , has a higher pH than one of sulfuric acid of the same concentration.

..... [1]

(ii) Describe a test, other than measuring pH, which can be carried out on both acid solutions to confirm the explanation given in (b)(i) for the different pH values of the two acids.

.....
 [2]

(c) Complete the following equations for reactions of these two acids.

(i) sodium hydroxide + malonic acid \rightarrow + [1]

(ii) $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow$ + [2]

(iii) $\text{Mg} + \text{CH}_2(\text{COOH})_2 \rightarrow$ + [2]

(iv) $\text{K}_2\text{CO}_3 + \text{H}_2\text{SO}_4 \rightarrow$ + + [2]

[Total: 16]

0620/s13/qp33

3 Fertilisers are used to promote plant growth.
Two fertilisers are ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, and calcium dihydrogenphosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$.

(a) Describe a test to distinguish between these two fertilisers.

test
..... [2]

result
..... [1]

(b) Many fertilisers are manufactured from ammonia. Describe how ammonia is made in the Haber process. Give the essential conditions and an equation for the process.

.....
.....
.....
..... [4]

(c) State the essential plant nutrient not supplied by ammonium phosphate.

..... [1]

(d) The soluble compound, calcium dihydrogenphosphate is made by heating the insoluble mineral rock phosphate, $\text{Ca}_3(\text{PO}_4)_2$, with sulfuric acid.

(i) Why would rock phosphate not be effective as a fertiliser?
..... [1]

(ii) The phosphate ion, PO_4^{3-} , from the rock phosphate is changed into the dihydrogenphosphate ion, H_2PO_4^- .



What type of reagent is the phosphate ion? Give a reason for your choice.

.....
..... [2]

(e) The extensive use of fertilisers and possibly the effect of acid rain tend to increase the acidity of the soil. State why it is necessary to control soil acidity and explain how this can be done.

.....
..... [2]

[Total: 13]

6 Soluble salts can be made by the neutralisation of an acid by a base. Insoluble salts can be made by precipitation.

(a) The following is a brief description of the preparation of the soluble salt, nickel(II) chloride-6-water, from the insoluble base nickel(II) carbonate.

Nickel(II) carbonate is added in small amounts to hot dilute hydrochloric acid until it is in excess. The mixture is filtered. The filtrate is partially evaporated and then allowed to cool until crystals of nickel(II) chloride-6-water form.

(i) Why is it necessary to use excess carbonate?

.....
 [1]

(ii) Explain why it is necessary to filter.

..... [1]

(iii) Why partially evaporate rather than evaporate to dryness?

.....
 [1]

(iv) What additional steps are needed to obtain dry crystals?

.....
 [2]

(b) Potassium chloride can be made from hydrochloric acid and potassium carbonate.

(i) Why must a different experimental method be used for this preparation?

.....
 [1]

(ii) Give a description of the different method used for this salt preparation.

.....

 [4]

(b) Antimony oxide is a white powder which is insoluble in water.
Describe how you would find out if it is a basic, an acidic or an amphoteric oxide.

.....

.....

.....

..... [4]

0620/w11/qp32

Fahad H. Ahmad

1 This question is concerned with the following oxides.

- sulfur dioxide
- carbon monoxide
- lithium oxide
- aluminium oxide
- nitrogen dioxide
- strontium oxide

(a) (i) Which of the above oxides will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Which of the above oxides will react with aqueous sodium hydroxide but not with hydrochloric acid?

..... [1]

(iii) Which of the above oxides will react with both hydrochloric acid and aqueous sodium hydroxide?

..... [1]

(iv) Which of the above oxides will not react with hydrochloric acid or with aqueous sodium hydroxide?

..... [1]

(b) Two of the oxides are responsible for acid rain. Identify the **two** oxides and explain their presence in the atmosphere.

.....
.....
.....
.....
..... [5]

0620/w11/qp31

8 Soluble salts can be made using a base and an acid.

(a) Complete this method of preparing dry crystals of the soluble salt cobalt(II) chloride-6-water from the insoluble base cobalt(II) carbonate.

Step 1

Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

Step 2

.....
.....

Step 3

.....
.....

Step 4

.....
.....

[4]

0620/w10/qp31

(b) Beryllium hydroxide, a white solid, is an amphoteric hydroxide.

(i) Name another metal which has an amphoteric hydroxide.

..... [1]

(ii) Suggest what you would observe when an excess of aqueous sodium hydroxide is added gradually to aqueous beryllium sulfate.

.....
..... [2]

0620/w10/qp31

(c) (i) Define the term *acid*.

..... [1]

(ii) Sulfuric acid is a strong acid. Ethanedioic acid is a weak acid.
Given solutions of both acids, how could you show that sulfuric acid is a strong acid and ethanedioic acid is a weak acid?

method

..... [1]

result for each acid

..... [1]

0620/w10/qp32

(ii) Carbon dioxide is acidic and methane is neutral.
Suggest another way of measuring the volume of methane in the sample.

.....

..... [2]

0620/w10/qp32

(c) Two of the oxidation states of vanadium are +3 and +4.

(i) Write the formula of vanadium(III) oxide and of vanadium(IV) oxide.

vanadium(III) oxide

vanadium(IV) oxide [2]

(ii) Vanadium(III) oxide is basic and vanadium(IV) oxide is amphoteric.
Describe how you would obtain a sample of vanadium(III) oxide from a mixture of these two oxides.

.....

.....

..... [3]

0620/w10/qp33

2 Oxides are classified as acidic, basic, neutral and amphoteric.

(a) Complete the table.

type of oxide	pH of solution of oxide	example
acidic		
basic		
neutral		

[6]

(b) (i) Explain the term *amphoteric*.

.....
..... [1]

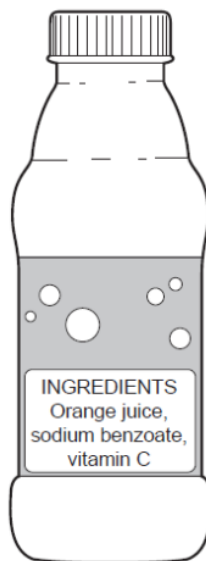
(ii) Name two reagents that are needed to show that an oxide is amphoteric.

.....
..... [2]

[Total: 9]

0620/w09/qp31

- 4 Across the world, food safety agencies are investigating the presence of minute traces of the toxic hydrocarbon, benzene, in soft drinks. It is formed by the reduction of sodium benzoate by vitamin C.



- (a) Sodium benzoate is a salt, it has the formula C_6H_5COONa . It can be made by the neutralisation of benzoic acid by sodium hydroxide.

- (i) Deduce the formula of benzoic acid.

..... [1]

- (ii) Write a word equation for the reaction between benzoic acid and sodium hydroxide.

..... [1]

- (iii) Name **two** other compounds that would react with benzoic acid to form sodium benzoate.

..... [2]

0620/w08/qp3

Page2	Page3	Page4	Page5	Page6	Page7	Page8	Page9	Page10	Page11
32a	19b	20a	30c	18d	31a	18d	32c	34d	32b
21c	32b	19b	20d	35b	20a	34a	17c	33c	27a
20c	22b	31a			19a	33b	16c		
	21b								

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18d	13b	20c	19b	20b	19c	21d	2c	20b	22d
19d	34d	17b	35b	21c	36d	16d	37c	21d	23a
17c		18a	22d		20a				
16b									

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3b	12c	20b	35b	19a	32d	20c	35d	21d	19d
15a	34a	17c	22c	20c	23a	21b	36a	22d	15c
16b	19b	18b		36a	22a			23a	
								20c	

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36b	35b	18a	20c	33a	31c	16d	12a	20d	22a
34a	21d	19c		34d	19c	17b	34a	21c	
	22c						19d		

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34b	30c	19a	35b	33a	16c	21c	19a	21d	19b
	21c	20a	34a	20c	34c	22d	18c	17c	33b
		9a		21c			16b	18d	
				19a					

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31c	20b	7a	29a	21c	20c	19c	33a	9b	19b
19d	16b	34b	19d	33a	21d	15d	20d	32b	17a
	17c		20a			35a	21d	20d	32c
	18a						19c		

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21a	9d	18a	20c	16c	17d
22a	33a	33c	21d	33a	18c
20b	19c	19c		30c	
19d					

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8 (a) (changes from) blue (1) to pink (1) [2]

(b) no more (solid) dissolves or no more cobalt(II) carbonate dissolves or no more effervescence or bubbling or fizzing [1]

filter(residue)/centrifuge/decant [1]

evaporate/heat/warm/boil/leave in sun

AND until most of the water has

gone/some water is left/until it is

concentrated/saturation

(point)/crystallisation

point/crystals form on glass rod or

microscope slide/crystals start to form

[1]

Leave/allow to cool/allow to

crystallise/filter (off

crystals)/wash(with distilled

water)/dry crystals with filter paper/dry

crystals in warm place or dry in oven or

dry on windowsill [1]

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6 (a) Rb loses 1 electron/1 electron in outer shell/1 valency or valence electron [1]

Sr loses 2 electrons/2 electrons in outer shell/2 valency or valence electrons [1]

(b) (i) (mix solutions of) rubidium

carbonate/Rb₂CO₃ [1]

strontium chloride/SrCl₂ or strontium

nitrate/Sr(NO₃)₂ or strontium

sulfate/SrSO₄ or strontium

hydroxide/Sr(OH)₂ [1]

COND (on two correct reactants) filter

or centrifuge or decant (the residue) [1]

wash with water and dry/press between

filter paper/put in (low) oven/put on a

(sunny) windowsill/put in sun/heat [1]

(c) (i) nitric acid or nitric(V) acid or HNO₃ [1]

(ii) 2KNO₃ = 2KNO₂ + O₂ [2]

Species (1)

Balance (1)

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1 (a) Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

solution pH

aqueous ammonia, weak base 10

dilute hydrochloric acid, a strong acid 1

aqueous sodium hydroxide, a strong base

13

aqueous sodium chloride, a salt 7

dilute ethanoic acid, a weak acid 3 [5]

(b) Hydrochloric acid strong acid or

ethanoic acid weak acid [1]

OR: hydrochloric acid completely ionised

or ethanoic acid

partially ionised

hydrochloric acid greater concentration

of/more H⁺ ions (than ethanoic acid) [1]

(c) Rate of reaction with Ca, Mg, Zn, Fe

[1]

Strong (hydrochloric) acid bubbles faster

or more bubbles or dissolves faster [1]

OR: rate of reaction with (metal)

carbonate [1]

strong (hydrochloric) acid faster or more

bubbles or dissolves faster (only if

carbonate insoluble) [1]

OR: electrical conductivity [1]

strong (hydrochloric) acid better

conductor [1]

[Total: 9]

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(b) Ba(C₆H₁₃SO₃)₂ / (C₆H₁₃SO₃)₂Ba [1]

(c) (i) _ magnesium hexanesulfonate + hydrogen [1]

(ii) _ calcium hexanesulfonate + water [1]

(iii) 2C₆H₁₃SO₃H + Na₂CO₃ → 2C₆H₁₃SO₃Na + CO₂ + H₂O

C₆H₁₃SO₃Na = (1) [1]

remaining species correct and equation

balanced = (1) [1]

(d) (i) measure pH / add universal indicator [1]

both acids have a low value / pH 0–2 / same colour / red [1]

or

measure rate with named reactive metal, Mg,

Zn (1)

both fast reactions (1)

or

measure rate using piece of insoluble carbonate, CaCO_3 (1)
both fast reactions (1)
NOTE: must be insoluble for first mark
or

measure electrical conductivity (1)
both good conductors (1)
(ii) to have same concentration of H^+ / one acid is H_2SO_4 , the other is $\text{C}_6\text{H}_{13}\text{SO}_3\text{H}$ / sulfuric acid is dibasic, hexanesulfonic is monobasic [1]
(iii) a strong acid is completely ionised, [1]
a weak acid is partially ionised [1]

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(c)

if the oxide is	predicted result with hydrochloric acid	predicted result with aqueous sodium hydroxide
acidic	NR	R
neutral	NR	NR
basic	R	NR
amphoteric	R	R

(1) per line [4]

5 (a) because they have more than one oxidation state or valency / form ions with different charges [1]
there are two iron oxides (iron(III) oxide and iron(II) oxide) / iron forms Fe^{2+} and Fe^{3+} compounds / iron forms iron(II) and iron(III) compounds [1]
(b) (i) to remove the precipitate / remove the silver(I) chromate(VI) / remove the residue [1]
(ii) to remove soluble impurities / remove named soluble salt e.g. potassium nitrate / remove reactants [1]
(iii) to dry solid / to remove water [1]
(c) (i) need one mole of potassium chromate(VI) for two moles of silver(I) nitrate / correct references to mole ratio [1]

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(b) (i) anhydrous cobalt chloride becomes hydrated [1]
ACCEPT: hydrous
(ii) carbon dioxide is acidic [1]
sodium hydroxide and calcium oxide are bases / alkalis [1]
(iii) Any two of:

water, calcium carbonate and sodium carbonate [2]
ACCEPT: sodium bicarbonate

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(b) (i) heat with carbon or coke or carbon monoxide; [1]
(ii) $\text{ZnO} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2\text{O}$ [2]
[1] for correct reactants [1] for correct products
(iii) zinc (not: ions) more reactive than silver and lead; [1]
zinc displaces both metals / silver and lead produced / ions become atoms / zinc reduces silver ions and lead ions; [1]
(silver and lead) can be removed by filtering / centrifugation / decanting; [1]
an ionic equation; i.e.
 $\text{Zn} + 2 \text{Ag}^+ \rightarrow \text{Zn}^{2+} + 2\text{Ag}$ or $\text{Zn} + \text{Pb}^{2+} \rightarrow \text{Zn}^{2+} + \text{Pb}$ [1]
allow: any two correct half equations

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(b) (i) strontium carbonate does not dissolve / no effervescence; [1]
note: not just reaction is complete
(ii) to remove excess / unreacted / undissolved strontium carbonate; [1]
(iii) water of crystallisation needed / $6\text{H}_2\text{O}$ in crystals / would get anhydrous salt / would not get hydrated salt / crystals dehydrate; [1]
not: just to obtain crystals

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(b) (i) strontium carbonate does not dissolve / no effervescence; [1]
note: not just reaction is complete
(ii) to remove excess / unreacted / undissolved strontium carbonate; [1]
(iii) water of crystallisation needed / $6\text{H}_2\text{O}$ in crystals / would get anhydrous salt / would not get hydrated salt / crystals dehydrate; [1]
not: just to obtain crystals

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7 (a) (i) add carbon / animal charcoal [1]
filter [1]
OR

repeat experiment without indicator [1]
using same quantity / volume of acid [1]
(ii) add magnesium metal / carbonate / oxide / hydroxide
to (hot) (hydrochloric) acid [1]
cond: until in excess or no more dissolves or reacts [1]
cond: filter (to remove unreacted solid) [1]

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6 (a) (i) proton or H⁺ acceptor [1]
(ii) (measure) pH or (use) UI indicator [1]
note: can be implied need not be explicit
sodium hydroxide has higher pH / ammonia(aq) has lower pH [1]
(this sentence would score 2 marks)
or
appropriate colours with UI / appropriate numerical values [1]
ammonia is closer to green, blue-green, turquoise or lighter blue
sodium hydroxide is darker blue / purple / violet [1]
or
measure electrical conductivity [1]
can be implied need not be explicit
ammonia (aq) is the poorer conductor/ sodium hydroxide is the better conductor [1]

(e) (i) pH increases [1]
(ii) oxygen needed for rusting / removes oxygen / reacts with oxygen [1]

(b) experiment 1 $\text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$

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(e) it would react with/dissolves in a named strong acid [1]
it would react with/dissolves in a named alkali [1]
it shows both basic and acid properties = 1 [1]
it reacts with both acids and bases/alkalis = 1 [1]
[max 2]

2 (a) nitric acid; [1]
sodium hydroxide / carbonate / hydrogen carbonate; [1]
copper(II) oxide / hydroxide / carbonate; [1]
any named soluble chloride; [1]
accept: hydrochloric acid / hydrogen chloride

silver(I) nitrate / ethanoate / sulfate; [1]
must be soluble silver salt not silver oxide / carbonate
zinc(II) sulfate [1]
(b) (i) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$ [2]
equation correct state symbols missing [1]
(ii) $\text{ZnCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$ [2]
correct formula for zinc sulfate = 1
[Total: 10]

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(b) (i) $\text{PCl}_3 + 3\text{H}_2\text{O} \rightarrow 3\text{HCl} + \text{H}_3\text{PO}_3$ [1]
(ii) acid solutions same concentration [1]
measure pH/pH paper/Universal indicator [1]
hydrochloric acid lower pH [1]
colours of Universal indicator can be given as red<orange<yellow
ignore precise pH values as long as HCl is lower than H_3PO_3
OR Acid solutions same concentration [1]
add magnesium or any named metal above Hydrogen in reactivity series but not above magnesium
calcium carbonate or any insoluble carbonate [1]
hydrochloric acid react faster/shorter time [1]
OR acid solutions same concentration [1]
measure electrical conductivity [1]
hydrochloric acid better conductor/bulb brighter [1]
OR acid solutions same concentration [1]
add sodium thiosulphate [1]
hydrochloric acid forms precipitate faster/less time [1]
(iii) sodium hydroxide/sodium carbonate [1]
titration cond on correct reagent [1]
second mark scores for mention of titration /burette/pipette/indicator.
experimental detail not required
any named soluble calcium salt e.g. calcium chloride/nitrate/hydroxide [1]
precipitation/filter/decant/centrifuge [1]

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5 (a) (i) $2\text{Li} + 2\text{HI} \rightarrow 2\text{LiI} + \text{H}_2$ [1]
(ii) zinc carbonate + hydriodic acid → zinc iodide + carbon dioxide + water [1]
(iii) $\text{MgO} + 2\text{HI} \rightarrow \text{MgI}_2 + \text{H}_2\text{O}$ [1]
(b) reaction 1 is redox / Li/2HI reaction [1]

cond reason either oxidation number/state /
electron transfer [1]

(d) (i) the reaction is exothermic / reaction
produces heat/energy [1]
all the sodium hydroxide used up/neutralised /
reaction has stopped [1]
(ii) adding colder acid / no more heat produced
[1]
if not given in (d)(i) any comments such as
"reaction has stopped" can gain mark
(iii) 1.33 / 1.3 / 1.3333 (mol/dm³) scores both
marks [2]
not 1.34

for a correct method – $M_1 V_1$ / moles of NaOH
= 0.02
with an incorrect answer only [1]

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(c) base [1]
not alkali
accepts a proton [2]
accepts hydrogen ion / H⁺ only [1]
proton and H⁺ [2]

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(d) (i) thalium sulfate + ammonia + water [1]
(ii) $2\text{TlOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$ [2]
not balanced = [1]
incorrect formula = [0]
(iii) green precipitate or solid (ignore shades of
green but not bluey green etc.) [1]
 $\text{Fe}^{2+} + 2\text{OH}^- \rightarrow \text{Fe}(\text{OH})_2$ accept multiples [1]

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6 (a) (i) Tl_2S [1]
(ii) TlCl_3 [1]
(b) filter / centrifuge / decant
wash the precipitate
dry the solid / heat the solid (in oven) / press
between filter paper [3]
all three stated but not in correct order = [2]
two out of three stated in any order = [1]
(c) (i) silver chloride / silver bromide [1]
photography / cameras / films / photo chromic
lenses / sunglasses [1]
(ii) increase distance between lamp and paper
or put lamp far away /
put a screen or translucent or semi-opaque
material between them /
use a less powerful or low voltage or dim lamp
/
lower the temperature

any two [2]

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(b) (i) because it accepts a proton [2]
accepts hydrogen ion or H⁺ ONLY [1]
proton and H⁺ [2]
(ii) hydrogen chloride is a strong acid [1]
hydrogen fluoride is a weak acid [1]
weaker or stronger correctly applied for [2]

(iii) hydrogen chloride (aqueous) would have
lower pH [1]
OR hydrogen fluoride (aqueous) would have
higher pH
If values suggested, not over 7
[Total: 8]

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5 (a) (i) $\text{Ca}^{2+} + 2\text{F}^- \rightarrow \text{CaF}_2$ [2]
Not balanced ONLY [1]
Both species must be correct for first mark.
Second mark is for correct balancing.
(ii) Mole ratio Ca²⁺: F⁻ is 1:2 [1]
Answer must mention moles
accept argument based on charges or number
of ions
accept 2 moles of NaF react with 1 mole of
CaCl₂
NOT just "2" in equation
If fluorine must specify atoms or ions
(iii) to remove traces of solutions or to remove
soluble
impurities or to remove a named salt sodium
chloride
or sodium fluoride or calcium chloride [1]
To remove impurities is not enough
(iv) to dry (precipitate) or to remove water or to
evaporate water [1]
NOT to evaporate some of water NOT to
crystallise salt

(b) $\text{T}_3(\text{PO}_4)_2$ allow correct example [1]
explain why 8 cm³ react fully [1]
comment about mole ratio [1]
[Total: 8]

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7 (a) repeat experiment without indicator or
use carbon to remove indicator [1]
(partially) evaporate or boil or heat [1]
allow to cool or crystallise or crystals [1]
dry crystals [1]
MUST be in correct order

NB evaporate to dryness, marks one and two ONLY

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(c) hydrogen chloride or hydrochloric acid [1]
carbon dioxide or carbonic acid or hydrogen carbonate [1]
(d) 8e around both chlorine atoms [1]
4e between carbon and oxygen atoms [1]
8e around carbon atom [1]
8e around oxygen [1]
if a bond contains a line with no electrons, no marks for atoms joined by that line
ignore keying

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4 (a) (i) magnesium + sulphuric acid = magnesium sulphate + hydrogen [1]
ACCEPT hydrogen sulphate
(ii) $\text{Li}_2\text{O} + \text{H}_2\text{SO}_4 \rightarrow \text{Li}_2\text{SO}_4 + \text{H}_2\text{O}$ [2]
formulae correct but not balanced [1]
(iii) $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{H}_2\text{O}$ [2]
OR $\text{CuO} + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O}$
OR $\text{CuO} + 2\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O}$
formulae correct but not balanced [1]
(iv) sodium carbonate + sulphuric acid → sodium sulphate + carbon dioxide + water [1]
(b) it accepts a proton [2]
it accepts a hydrogen ion [1] ONLY
(c) sulphuric acid is completely ionised [1]
or few molecules and many ions
ethanoic acid is partially ionised [1]
or many molecules and few ions
[Total: 10]

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3 (i) method C [1]
sulphuric acid (allow if given in equation) [1]
zinc oxide + sulphuric acid = zinc sulphate + water [1]
(ii) method A [1]
hydrochloric acid [1]
 $\text{KOH} + \text{HCl} = \text{KCl} + \text{H}_2\text{O}$ [1]
(iii) method B [1]
potassium iodide or any soluble iodide [1]
 $\text{Pb}^{2+} + 2\text{I}^- = \text{PbI}_2$ accept a correct equation even if soluble iodide is wrong [2]
Not balanced - $\text{Pb}^{2+} + \text{I}^- = \text{PbI}_2$ ONLY [1]
[Total: 10]

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3 (a) ammonia 10

hydrochloric acid 1
sodium hydroxide 13
ethanoic acid 4
All correct [2]
Two correct [1]
(b) With strong acid bulb brighter [1]
faster rate of bubbles [1]
OR corresponding comments for weak acid
(c) proton NOT hydrogen ion [1]
 H^+ not conditional on proton [1]
Only way for [2] is proton and H^+
(d) (i) CaO and MgO [1]
(ii) CO_2 and SO_2 [1]
(iii) Al_2O_3 [1]
(iv) CO [1]
[TOTAL = 10]

(c) reaction no reaction [1]
reaction reaction [1]

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4 (a) (i) correct word equation (carbon dioxide and water) [1]
Accept correct symbol equation
(ii) Must have a correct reagent otherwise wc = 0
add (acidified) barium chloride(aq) or nitrate or add barium ions [1]
COND white precipitate [1]
NOT lead(II) compounds
(iii) low pH or universal indicator turns red(aq) [1]
pH 3 or less

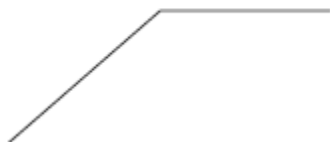
(b) (i) to remove fibres or remove solid
NOT precipitate, NOT impurities, NOT to obtain a filtrate [1]
(ii) because silver atoms have lost electrons [1]
OR oxidation number increased
(iii) silver chloride [1]

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2 (a) $\text{Zn} + \text{I}_2 = \text{ZnI}_2 + 2\text{I}^-$ [2]
For having either reactants or products correct ONLY [1]
(b) for zinc and sodium hydroxide white precipitate [1]
dissolves in excess (only if precipitate mentioned) [1]
for zinc and ammonia same results [1]
Mark either first (sodium hydroxide or aqueous ammonia), if completely correct, then an additional [1] can be awarded for stating that the other has the same results.

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- 4 (a) (i) Named soluble zinc salt [1]
corresponding sodium salt [1]
If hydroxide or oxide then 0/2
(ii) Correct equation [2]
not balanced [1] only
(iii) Correct equation [2]
(b) (i) $\text{Fe}^{3+} + 3\text{OH}^- = \text{Fe}(\text{OH})_3$ [1]
(ii) Max at 8cm³
[1]
Same shape of graph



Just the above shape, the height of the precipitate and the volume of sodium hydroxide are irrelevant [1]

- (iii) Maximum then height of precipitate decreases [1]
or graph slopes down to x axis or comes to zero
hydroxide dissolves in excess or it is amphoteric [1]

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- (b) (i) potassium [1]
(ii) ammonium sulphate [1]
(iii) $\text{Ca}_3(\text{PO}_4)_2$ [1]
 $\text{Ca}(\text{H}_2\text{PO}_4)_2$ [1]
(iv) only acceptable responses are:
accepts a proton [2]
accepts H^+
[1] only

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(d) Add excess lead oxide to nitric acid
can imply excess
filter NOT if residue is lead nitrate
evaporate or heat solution

- (b) (i) white precipitate
COND upon a precipitate
dissolves in excess or forms solution
[1]
[1]
(ii) blue precipitate
COND upon a precipitate
does not dissolve in excess
[1]

[1]

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- 5 (a) (i) equilibrium to left or many molecules
and few ions or
partially ionised or reverse reaction favoured
[1]
(ii) Water donates proton [1]
methylamine accepts a proton [1]
NOTE If hydrogen ion then ONLY [1] provided
both are correct
(b) less than 12 more than 7 [1]
smaller concentration of hydroxide ions or
partially dissociated or
poor proton acceptor or poor H^+ acceptor [1]
NOT it is a weak base
(c) (i) $\text{CH}_3\text{NH}_2 + \text{HCl} = \text{CH}_3\text{NH}_3\text{Cl}$ [1]
methylammonium chloride [1]
NOTE the equation must be as written, the
equation with sulphuric acid has been
given as guidance.
(ii) brown precipitate [1]
ACCEPT orange or red/brown or brick red or
brown/red
(iii) sodium hydroxide or any named strong
base [1]
[Total: 9]

PAGE 100

- (c) (i) Any reasonable explanation
Plants prefer soil pH about 7
Plants do not grow (well) in acidic soils/plants grow
better
To increase crop yields
Any ONE [1]
Do NOT accept in acidic soils plants die
(ii) With calcium carbonate, pH cannot go above 7
[1]
It is not washed away by the rain/remains longer in
the soil
It is not absorbed by the plant [1]
OR
With calcium oxide, pH can go above 7 [1]
It is washed away by the rain [1]
(iii) Any correct use - making steel/iron, making
cement, making glass, [1]
disposing of acid wastes, removing sulphur dioxide
from flue
gases, (stone in) building, indigestion tablets,
toothpaste, cosmetics etc
(b)(i) sulphuric acid
COND description of titration
repeat without indicator or with carbon
evaporation
any TWO [3]
(ii) suitable reactants calcium chloride and
sodium fluoride [1]
COND upon correct reagents

filter [1]
wash and dry precipitate [1]
OR Accept synthesis
calcium [1]
fluorine [1]
burn or heat [1] [3]

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(b)(i) calcium ethanoate + hydrogen [1]
(ii) zinc oxide or hydroxide [1]
(c) $\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$
[2]
reactants [1] products [1]

2 dilute
filter
saturated
cool
blue
sulphate [6]

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5 (a) (i) preserve food **or** sterilising
(ii) making paper

(c) (i) proton
hydrogen ion **or** H^+ **ONLY** [1]
(ii) correct equation molecular **or** ionic
 $\text{NH}_3 + \text{HCl} = \text{NH}_4\text{Cl}$
 $\text{NH}_3 + \text{H}^+ = \text{NH}_4^+$ accept NH_4OH
(d) measure pH **or** add universal indicator **or** pH meter
ammonia has lower pH if numerical values given

(b) (i) manganese chloride
water
(ii) manganese(III) and (IV) oxides

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(b) sodium hydroxide **or** carbonate **or** hydrogencarbonate

zinc oxide **or** hydroxide **or** carbonate
NOT zinc

barium nitrate **or** chloride **or** hydroxide **or** barium ions

neutralisation **NOT** acid/base
(c) (i) copper sulphate **or** anhydrous copper sulphate
accept "unhydrated"
NOT formula
(ii) goes blue **or** becomes hot **or** steam
(iii) copper oxide

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8 (a) same general formula
same chemical properties
same functional group
physical properties vary in predictable way
common methods of preparation
consecutive members differ by CH_2
any two [2]
mark first two
ignore others unless it contradicts a point
which has been awarded a mark
(b) (i) $2\text{HCOOH} + \text{CaCO}_3 \rightarrow \text{Ca}(\text{HCOO})_2 + \text{CO}_2 + \text{H}_2\text{O}$ [2]
not balanced = [1]
(ii) zinc + methanoic acid _ zinc methanoate +
hydrogen [2]
[1] for each product
(iii) protected by oxide layer [1]
(c) butanoic acid [1]
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-COOH}$ / $\text{C}_4\text{H}_8\text{O}_2$ / $\text{C}_3\text{H}_7\text{COOH}$ /
 $\text{C}_4\text{H}_7\text{OOH}$ [1]
 $\text{C}_2\text{H}_4\text{O}$ [1]
mark ecf to molecular formula

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7 (a) repeat without indicator / repeat
using same volumes of acid and alkali **or**
use
carbon / charcoal to remove indicator (1)
evaporate / heat / warm / boil / leave in
sun (1)
until most of the water has gone / some
water is left / saturation (point) /
crystallisation point (1)
leave / allow to cool / allow to
crystallise (1)
filter (off crystals) / wash (with
distilled water) / dry crystals with
filter paper / dry
crystals in warm place / oven /
windowsill (1) [5]

(c) name or formula of strong acid and
alkali (1)
reacts with or neutralises both acid and
base or alkali (then amphoteric) (1)
it dissolves / soluble in both (acid and
alkali) or form solutions in both (1) [3]

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(c) (i) zinc + propanoic acid \rightarrow zinc
propanoate (+ hydrogen) (1) [1]

(ii) calcium oxide + propanoic acid → calcium propanoate + water (1) [1]
(iii) $\text{LiOH} + \text{CH}_3\text{CH}_2\text{COOH} \rightarrow \text{CH}_3\text{CH}_2\text{COOLi} + \text{H}_2\text{O}$
(1) [1]

(ii) potassium / K (1)
phosphorus / P (1) [2]
(b) (i) burn fossil fuels / burn fuels containing sulfur / burn compounds containing sulfur / burn ores containing sulfur / roast metal sulfides / burn metal sulfides
(1)
sulfur dioxide / SO_2 (formed) (1)
(form) sulfuric / H_2SO_4 / sulfurous acid / H_2SO_3 (1)
OR
nitrogen and oxygen (in air) react at high temperatures / in jet engines / car engines / lightning. (1)
(form) oxides of nitrogen (1)
(form) nitric acid / HNO_3 / nitrous acid / HNO_2 (1) [3]

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(b) (i) malonic is a weaker acid/less dissociated
OR sulfuric acid is a stronger acid/more dissociated [1]
NOT sulfuric acid is a strong acid
(ii) add piece of suitable metal, e.g. Mg
ALLOW Al, Ca **NOT** K, Na, Cu [1]
sulfuric acid reacts faster **OR** malonic reacts slower [1]
OR
as above add a piece of CaCO_3 , if soluble carbonate then [1] only
OR measure electrical conductivity [1]
sulfuric acid is the better conductor
OR malonic acid poorer conductor [1]
NOT sulfuric acid is a good conductor

(c) (i) sodium malonate and water [1]
(ii) CuSO_4
 H_2O [2]
(iii) $\text{CH}_2(\text{COO})_2\text{Mg}$
 H_2 [2]
(iv) K_2SO_4
 CO_2 and H_2O **NOT** H_2CO_3 [2]

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3 (a) sodium hydroxide solution [1]

warm [1]
(only) ammonium phosphate gives off ammonia / gas (which will turn red litmus paper blue) [1]
or:
sodium hydroxide solution [1]
dissolve fertiliser in water [1]
 Ca^{2+} gives (white) ppt [1]
or:
flame test [1]
 Ca^{2+} brick red / orange / orange-red [1]
 NH_4
+ no colour [1]
(b) iron catalyst [1]
pressure 150–300 atmospheres [1]
temperature 370–470 °C [1]
 $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ [1]
note: units required for temperature and pressure
(c) potassium / K [1]
(d) (i) needs to be soluble / in solution (to be absorbed by plants) [1]
(ii) base [1]
proton acceptor [1]
(e) plant growth depends on soil acidity or pH / plants have optimum pH (for growth) [1]
add $\text{Ca}(\text{OH})_2$ / CaO / CaCO_3 / lime / slaked lime / quicklime / limestone [1]

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6 (a) (i) to neutralise all the acid / so all acid reacts [1]
not: reaction goes to completion
(ii) remove excess carbonate / removes unreacted carbonate [1]
not: remove solid
(iii) need water of crystallisation / hydrated crystals / to get crystals [1]
(iv) filter / decant / wash crystals [1]
dry with filter paper or tissues etc. [1]
accept: in warm oven / warm place / in sun
not: just heat
(b) (i) potassium carbonate is soluble / both salts soluble [1]
(ii) use potassium carbonate solution [1]
accept: implication of solution – in pipette / burette / 25 cm³
titrate / titration term required [1]
use an indicator **accept:** any named acid/base indicator [1]

repeat without indicator / use carbon to remove indicator [1]

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(b) test it with both hydrochloric acid and sodium hydroxide(aq) [1]
accept: any named strong acid and any strong alkali
if only acid and alkali given then max = 3
basic oxide reacts with acid [1]
acidic oxide reacts with alkali/base [1]
amphoteric reacts with both [1]
accept: for react – form salt and water

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1 (a) (i) lithium oxide / strontium oxide [1]
(ii) sulfur dioxide / nitrogen dioxide [1]
(iii) aluminium oxide [1]
(iv) carbon monoxide [1]
accept: correct formulae
(b) sulfur dioxide [1]
burn (fossil) fuel containing sulfur / volcanoes [1]
nitrogen dioxide [1]
reaction of nitrogen and oxygen [1]
high temperatures / in car engine [1]
not: exhaust

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8 (a) filter / centrifuge / decant [1]
(partially) evaporate / heat / boil [1]
allow to crystallise / cool / let crystals form [1]
dry crystals / dry between filter paper / leave in a warm place to dry [1]
“dry” on its own must be a verb
evaporate to dryness only marks 1 and 2
note if discuss residue only mark 1

(b) (i) zinc / aluminium / lead / tin / chromium [1]
(ii) white precipitate [1]
precipitate dissolves / colourless solution forms / forms a clear solution / soluble in excess [1]

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(c) (i) proton donor [1]
(ii) measure pH / use pH paper [1]
sulfuric acid has the lower pH [1]
accept colours / appropriate numerical values
OR

measure electrical conductivity [1]
sulfuric acid is the better conductor [1]

OR

add magnesium / named fairly reactive metal [1]
ethanedioic acid gives the slower reaction [1]

NOTE result must refer to rate not amount

OR

add a carbonate [1]
ethanedioic acid gives the slower reaction [1]

NOTE result must refer to rate not amount

(ii) add sodium hydroxide(aq) / alkali [1]
carbon dioxide dissolves, leaving methane [1]

(c) (i) V_2O_3 [1]
 VO_2 [1]
(ii) add sodium hydroxide(aq) or other named alkali [1]
not ammonia
cond vanadium(IV) oxide dissolves / reacts [1]
filter (to remove vanadium(III) oxide) [1]

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2 (a) pH < 7 [1]
example [1]
pH > 7 [1]
example [1]
NOT amphoteric oxides Be, Al, Zn, Pb, Sn etc
pH = 7 [1]
example H_2O , CO, NO [1]
the two marks are not linked, mark each independently
NOT amphoteric oxides Be, Al, Zn, Pb, Sn etc.
(b) (i) shows both basic and acidic properties [1]
(ii) a named strong acid [1]
a named alkali [1]

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4 (a) (i) C_6H_5COOH or $C_6H_5CO_2H$ [1]
NOT $C_7H_6O_2$ / C_6H_6COO
(ii) sodium hydroxide + benzoic acid = sodium benzoate + water [1]

correct spelling needed NOT benzenoate
ACCEPT correct symbol equation
(iii) sodium carbonate or oxide or
hydrogencarbonate
any TWO [2]
NOT Na