

**O Level | 5070**

# **CHEMISTRY**

## **TOPICAL PAPER 2**

**June 2011 – June 2022**

**All Variants**

**MARK SCHEME**

**Arranged Sub-topic wise**

**CAIE 2023-2024-2025 Syllabus**

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## Content for Chemistry Paper 2 Topical

<b>Chapter 1</b>	<b><u>Experimental Chemistry</u></b>	
	1.2 Methods of purification & analysis.....	6
	1.3 Identification of ions and gases.....	14
	<b>Mark Scheme</b> .....	<b>32</b>
<b>Chapter 2</b>	<b><u>The Particulate Nature of Matter</u></b>	
	2.1 Kinetic particle theory.....	45
	2.2 Atomic structure.....	66
	2.3 Bonding Structure and Properties.....	82
	<b>Mark Scheme</b> .....	<b>124</b>
<b>Chapter 3</b>	<b><u>Formulae, Stoichiometry &amp; the Mole Concept</u></b>	
	3 Mole.....	159
	3.1 Yield.....	219
	3.2 Empirical Formula.....	224
	3.3 Equations.....	243
	<b>Mark Scheme</b> .....	<b>253</b>
<b>Chapter 4</b>	<b><u>Electrolysis</u></b>	
	4 Electrolysis.....	291
	<b>Mark Scheme</b> .....	<b>309</b>
<b>Chapter 5</b>	<b><u>Energy from Chemicals</u></b>	
	5 Energy from Chemicals.....	317
	<b>Mark Scheme</b> .....	<b>338</b>
<b>Chapter 6</b>	<b><u>Chemical reactions</u></b>	
	6.1 Rate of Reaction.....	346
	6.2 Redox.....	382
	6.3 Reversible Reactions.....	395
	<b>Mark Scheme</b> .....	<b>415</b>

<b>Chapter 7</b>	<b><u>The Chemistry and uses of Acids, Bases and Salts</u></b>	
	7.1 Acids and Bases.....	440
	7.2 Preparation of Salts.....	459
	7.3 Properties & uses of Ammonia.....	471
	7.4 Sulfuric Acid.....	474
	<b>Mark Scheme.....</b>	<b>476</b>
<b>Chapter 8</b>	<b><u>The Periodic Table</u></b>	
	8 The Periodic Table .....	492
	<b>Mark Scheme.....</b>	<b>508</b>
<b>Chapter 9</b>	<b><u>Metals</u></b>	
	9.1 Properties of Metals.....	517
	9.2 Reactivity Series.....	524
	9.3 Extraction of Metals.....	541
	<b>Mark Scheme.....</b>	<b>546</b>
<b>Chapter 10</b>	<b><u>Atmosphere and Environment</u></b>	
	10.1 Air.....	560
	10.2 Water.....	574
	<b>Mark Scheme.....</b>	<b>579</b>
<b>Chapter 11</b>	<b><u>Organic Chemistry</u></b>	
	11.1 & 11.2: Alkane & Alkenes.....	589
	11.3 & 11.4: Alcohol & Carboxylic Acids.....	626
	11.5: Polymers.....	661
	<b>Mark Scheme.....</b>	<b>688</b>
<b>Chapter 1</b>	<b><u>General Question</u></b>	
	General Question .....	730
	<b>Mark Scheme.....</b>	<b>759</b>

7\ UdhYf '1

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## Experimental Chemistry

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# Chemistry 5070 Topical Paper 2

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@G>#76GG7#M7G75G75J5@B



In this 7\ UdhYf

You will practice the following topics:

- 1.2 Methods of purification and analysis
- 1.3 Identification of ions and ; ases

STUDENTS RESOURCE



5070/22/O/N/11/Q2

3 Pure oxygen for industrial use is obtained from the air.

(a) (i) State the percentage by volume of oxygen in clean air.

..... [1]

(ii) Explain how fractional distillation is used to obtain oxygen from the air.

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

5070/22/O/N/12/Q5

4 Nickel can be refined by reacting the impure metal with carbon monoxide. The impurities do not react with carbon monoxide.  
 A volatile compound called nickel carbonyl is formed.  
 This is decomposed to give pure nickel and carbon monoxide.

(a) (i) Explain the meaning of the term *volatile*.

..... [1]

(ii) Suggest how nickel carbonyl might be decomposed.

..... [1]

(iii) Explain how this method separates nickel from its impurities.

..... [1]

5070/22/O/N/1&Q, fMJK

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

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

STUDENTS RESOURCE

**5070/22/M/J/14/Q3**

- 6 Proteins are hydrolysed to give a mixture of colourless amino acids.

Describe, with the aid of a labelled diagram, how paper chromatography can be used to identify the amino acids present in a mixture of amino acids.

.....

.....

.....

.....[4]

**5070/21/O/N/14/Q3**

- 7 Paper chromatography can be used to separate metal ions in a mixture and identify them by comparison with known samples of metal ions (A–E).

(a) Draw a labelled diagram to show the apparatus used in paper chromatography.

On your diagram show

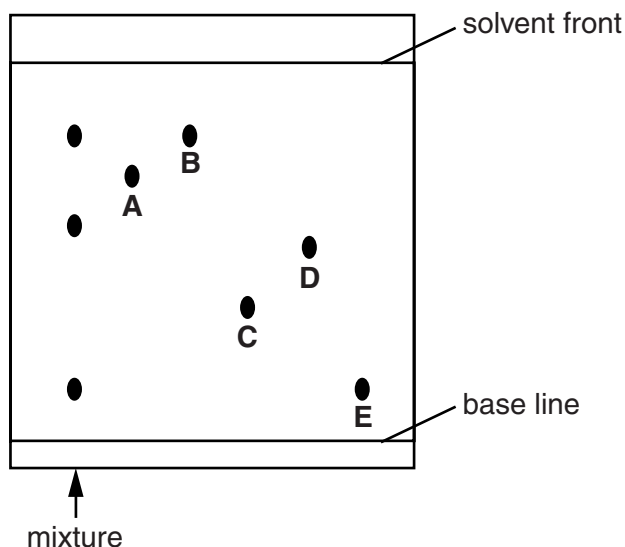
- the solvent,
- where the mixture of metal ions and known samples of metal ions are placed at the start of the experiment.

[2]

STUDENTS RESOURCE



(b) The completed chromatogram is shown below.



(i) Which of the metal ions, **A–E**, were present in the mixture?

.....[1]

(ii) Calculate the  $R_f$  value of metal ion **A**.

$R_f$  value = .....[1]

(c) Ammonia can be used as a locating agent for some metal ions on the chromatogram.

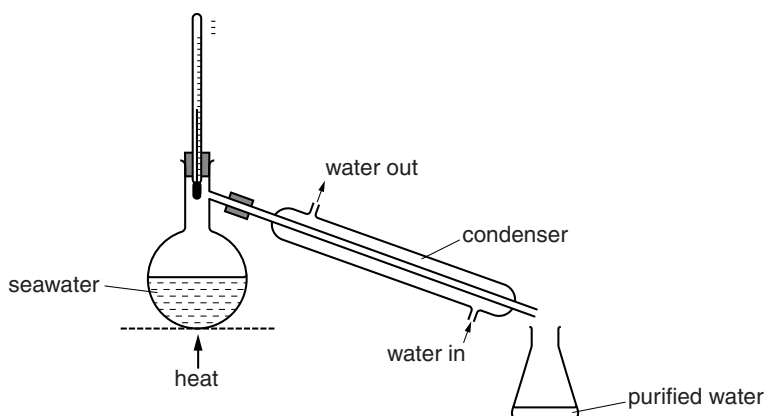
(i) Suggest why a locating agent may need to be used.

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

**5070/22/O/N/14/Q3**

**8** Seawater contains a variety of dissolved salts.

(a) The diagram shows a simple distillation apparatus that can be used to produce purified water from seawater.



STUDENTS RESOURCE

Explain how distillation purifies seawater.

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

5070/2/C/B/1( /E'

9 Ammonia can be used as a locating agent for some metal ions on the chromatogram.

(i) Suggest why a locating agent may need to be used.

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

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

Describe what you would observe as the ammonia is added.

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

5070/21/M/J/17/Q9fM

10 (f) A mixture of neon, argon, krypton and xenon can also be separated by diffusion.

Explain why.

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

STUDENTS RESOURCE

5070/22/O/N/17/Q4

- 11 Lavender flowers contain a variety of coloured compounds. These can be extracted from the flowers to give a solution of the coloured compounds.

Describe how to use paper chromatography to identify these coloured compounds.

You may use a labelled diagram in your answer.

.....

.....

.....

..... [3]

5070/21/M/J/19/Q2

- 12 Magnesium chloride is a soluble salt.

Describe how a pure sample of magnesium chloride crystals can be made from magnesium.

.....

.....

.....

..... [4]

5070/22/M/J/19/Q2

- 13 Aluminium chloride is a soluble salt.

Describe how a pure sample of aluminium chloride crystals can be made from aluminium.

.....

.....

.....

.....

.....

.....

..... [4]

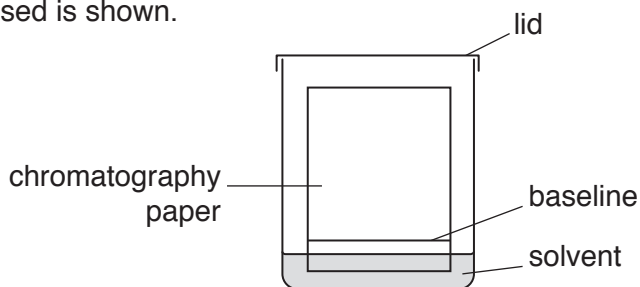
STUDENTS RESOURCE



5070/22/O/N/19/Q9

16 Paper chromatography can be used to separate a mixture of amino acids.

The apparatus used is shown.



(i) Why should the baseline be drawn in pencil and not in ink?

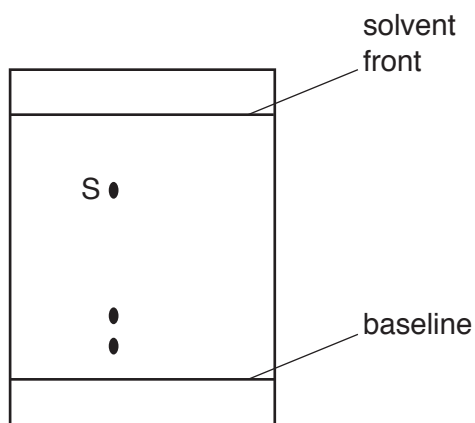
.....  
 ..... [1]

(ii) When the separation of the amino acids is complete, the chromatography paper is sprayed with a locating agent.

Explain why.

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

(iii) The diagram shows the chromatography paper after it has been sprayed with a locating agent.



Calculate the  $R_f$  value of the amino acid labelled S.

$R_f$  value ..... [1]

STUDENTS RESOURCE

# Topic 1.3 Identification of Ions & Gases

5070/21/M/J/11/Q&

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

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

- (a) Name gas **Z**.

.....[1]

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

.....[1]

- (c) When aqueous sodium hydroxide was added to the cooled reaction mixture, it initially reacted with excess sulfuric acid.

Write the ionic equation for this reaction.

[1]

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

.....[1]

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

[2]

5070/21/M/J/11/Q(

- 2 When aqueous iron(II) ions are warmed with aqueous hydrogen peroxide, iron(III) ions are formed.

- (i) Construct an ionic equation for the oxidation of iron(II) ions to iron(III) ions.

[1]

- (ii) Describe a chemical test that can be used to confirm that iron(II) ions have been oxidised to form iron(III) ions.

.....

.....[2]

## 5070/21/O/N/11/Q6

- 3 When hydrated sodium sulfate crystals are heated gently, water is given off.

Describe a chemical test for water.

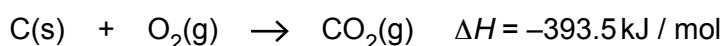
test .....

observation ..... [2]

## 5070/22/O/N/11/Q4

- 4 Coal is largely carbon.

(a) Carbon burns in excess air to form carbon dioxide.



(ii) Give a test for carbon dioxide.

test .....

observation ..... [2]

## 5070/22/M/J/12/Q2

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

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

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

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

STUDENTS RESOURCE

(a) (i) Name the white precipitate, **W**.  
 ..... [1]

(ii) Construct the ionic equation, with state symbols, for the formation of **W**.  
 ..... [2]

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

**X** is .....

**Y** is ..... [2]

**5070/21/O/N/12/Q7**

6 (i) Concentrated nitric acid reacts with tin to form tin(IV) oxide, SnO<sub>2</sub>, nitrogen dioxide and water.  
 Construct an equation for this reaction.

[1]

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

.....

.....

..... [3]

**5070/22/O/N/13/Q8**

7 An aqueous solution of hydrogen iodide contains iodide ions.

Describe a test for iodide ions.

.....

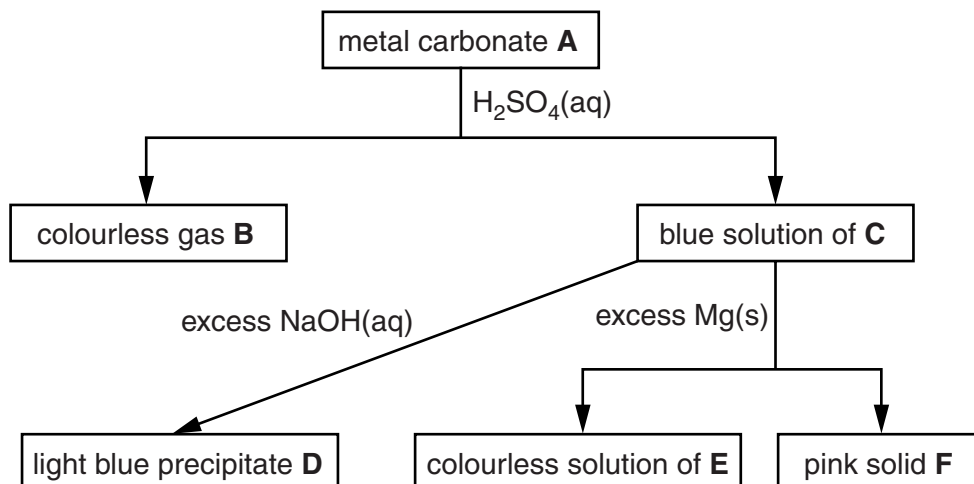
..... [2]

STUDENTS RESOURCE



5070/21/M/J/1(/Q\*

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



Identify, by name, each of the substances.

- A .....
- B .....
- C .....
- D .....
- E .....
- F .....

5070/21/M/J/1(/Q,

9 Butanoic acid reacts with magnesium.

Name the gas formed and describe the chemical test for the gas.

gas .....

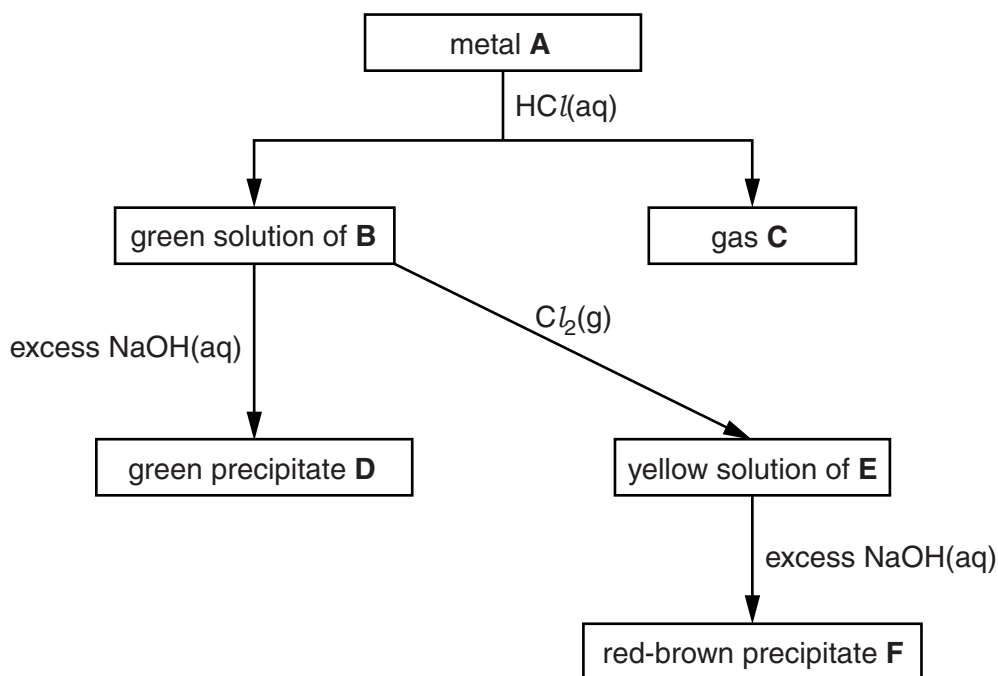
chemical test .....

..... [2]

STUDENTS RESOURCE

5070/2&M/J/1( /E\*`

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



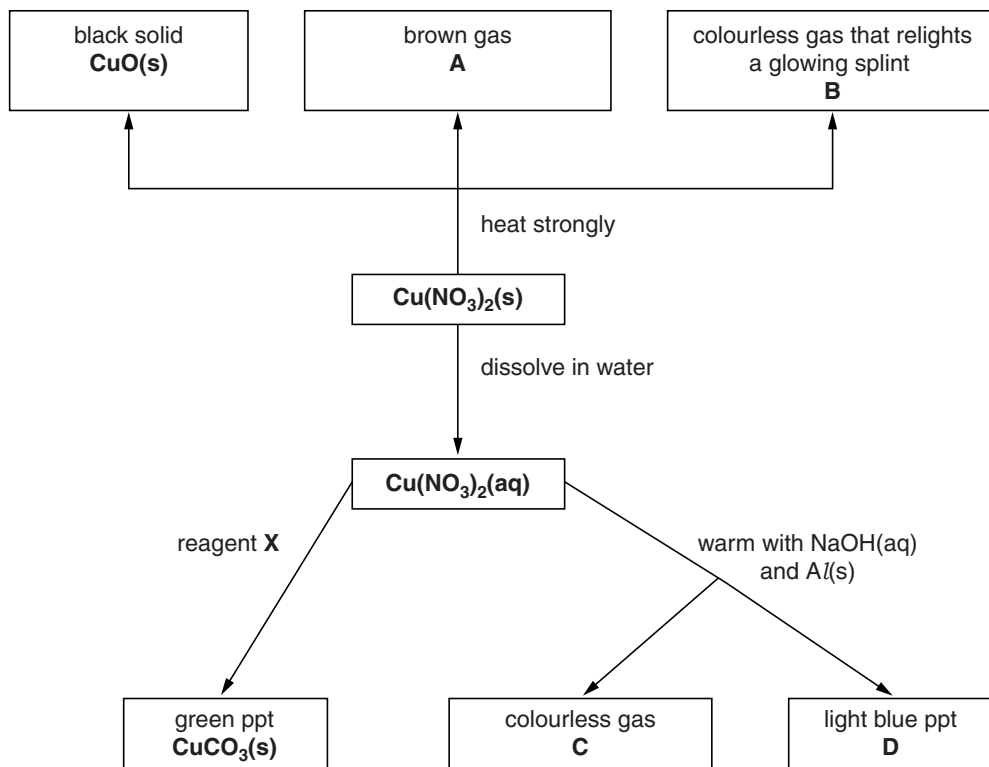
Identify, by name, each of the substances.

- A .....
- B .....
- C .....
- D .....
- E .....
- F .....

STUDENTS RESOURCE

5070/2/A/1/E)

11 The flow chart shows some reactions of copper(II) nitrate,  $\text{Cu}(\text{NO}_3)_2$ .



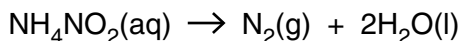
(b) Aqueous copper(II) nitrate is warmed with aqueous sodium hydroxide and aluminium powder. Name **C** and **D**.

**C** is .....

**D** is ..... [2]

5070/2/A/1/E\*

12 An aqueous solution of ammonium nitrite,  $\text{NH}_4\text{NO}_2$ , decomposes when heated gently.



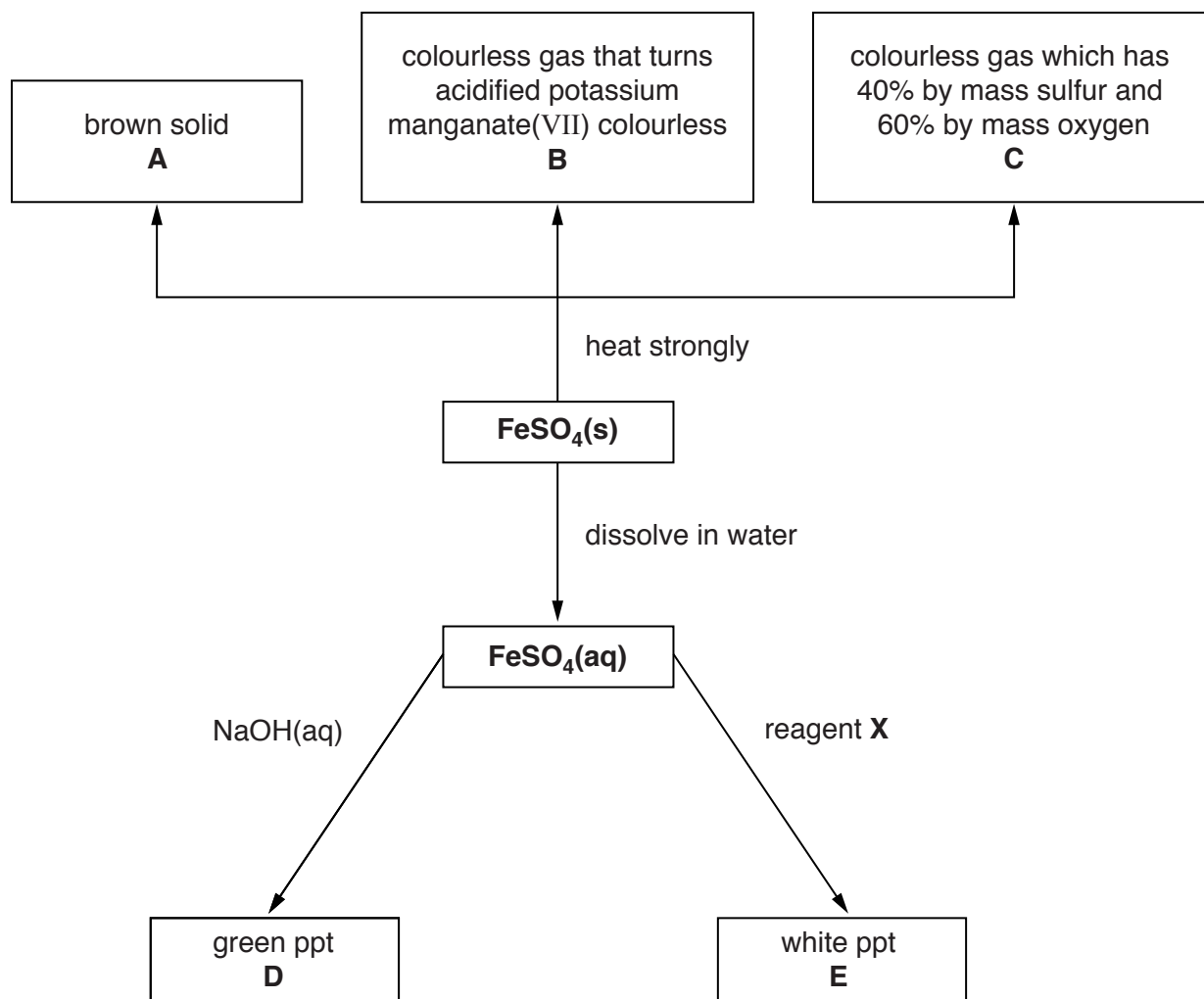
(a) Describe how you could show that aqueous ammonium nitrite contains ammonium ions.

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

STUDENTS RESOURCE

5070/2&A/>/1) /E (

13 The flow chart shows some reactions of iron(II) sulfate,  $\text{FeSO}_4$ .



(a) Iron(II) sulfate is heated strongly.

(i) Write the formula of gas B.

.....[1]

STUDENTS RESOURCE

- (iii) Two moles of iron(II) sulfate decompose to form one mole of solid **A**, one mole of gas **B** and one mole of gas **C**.

Deduce the formula of solid **A**.

formula of **A** .....[1]

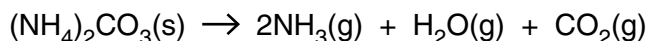
- (c) Suggest the name of reagent **X** and give the formula for the white precipitate **E**.

name of reagent **X** .....

formula of precipitate **E** .....[2]

5070/2&A/>/1)/E\*

- 14 Ammonium carbonate,  $(\text{NH}_4)_2\text{CO}_3$ , is a white solid that is a component of 'smelling salts'. It decomposes when it is heated.



- (a) A sample of ammonium carbonate is heated strongly until it all decomposes. Suggest what you would observe during the experiment.

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

- (b) Describe how you would show that both ammonia and carbon dioxide are formed in this decomposition.

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

STUDENTS RESOURCE

5070/2%**C/B/1**) /E\*

- 15 Copper corrodes slowly in damp air.  
One of the corrosion products has the formula  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ .

(ii) How could you show that  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$  contains carbonate ions?

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

5070/2%**C/B/1**) /E\*

- 16 Aqueous hydrochloric acid contains chloride ions.

Describe a test for chloride ions.

test .....

result ..... [2]

5070/2%**A/1**) /E\*

- 17 A mixture of iron powder and zinc powder is added to excess sulfuric acid.

When the reaction stops, aqueous sodium hydroxide is added drop by drop to the reaction mixture until it is in excess.

Describe what you would observe during the addition of aqueous sodium hydroxide and explain the reactions taking place.

observations

.....

explanations

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

[4]

STUDENTS RESOURCE

(ii) Describe the chemical test for sulfur dioxide.

test .....

.....

observation .....

.....

[2]

5070/2&A/>/1\* /E%

18 Chlorine is bubbled through aqueous iron(II) chloride to form iron(III) chloride.

Explain, with the aid of equations, how aqueous sodium hydroxide can be used to distinguish between aqueous iron(II) chloride and aqueous iron(III) chloride.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(e) Describe the chemical test for chlorine.

test .....

.....

observation .....

.....

[2]

STUDENTS RESOURCE

5070/2/C/B/1\*/E(

19 Iron(III) ions react with iodide ions.

(iii) Describe a test for iron(III) ions.

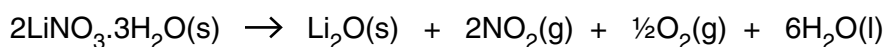
test .....

observation .....

[2]

5070/2/C/B/1\*/E%

20 A sample of hydrated lithium nitrate is heated in a test-tube.



What is observed during this reaction?

.....[1]

5070/2/C/B/1\*/E&

21 Farmers add fertilisers such as ammonium sulfate to the soil to increase the rate of plant growth.

(a) Write the formulae of the ions present in ammonium sulfate.

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

(b) Describe a test for ammonium ions.

test .....

observation .....

[2]

5070/2/C/B/1\*/E%

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

What is observed as the aqueous ammonia is added?

.....

.....[2]

STUDENTS RESOURCE



5070/2/A #/1+E +

23 To a sample of  $\text{Cu}(\text{NO}_3)_2(\text{aq})$ , a student adds aqueous ammonia drop by drop until it is in excess.

(i) Describe what is observed.

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

(ii) The student repeats the experiment but adds aqueous sodium hydroxide instead of aqueous ammonia.

Describe what is observed.

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

5070/2/A #/1+E +

24 To a small sample of  $\text{CuSO}_4(\text{aq})$ , a student adds aqueous sodium hydroxide drop by drop until it is in excess.

(i) Describe what would be observed.

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

(ii) The student repeats the experiment but adds aqueous ammonia instead of aqueous sodium hydroxide.

Describe what would be observed.

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

STUDENTS RESOURCE

5070/8/C/B/1+E,

25 Describe a test for ammonia.

test .....

result .....

[2]

5070/8/C/B/17#Q&

26 Chlorine and hydrogen are manufactured by the electrolysis of concentrated aqueous sodium chloride.

Chlorine is released at the positive electrode and hydrogen is released at the negative electrode.

(iii) Describe a test for chlorine.

test .....

result .....

[2]

5070/8/C/B/17#Q,

27 Describe a test for sulfate ions.

test .....

result .....

[2]

5070/8/A/>1, #Q&

28 Describe the chemical test for chlorine gas.

test .....

observation .....

.....

[2]

STUDENTS RESOURCE

5070/8%/A />/1, #Q+

29 Dilute sulfuric acid reacts with Fe<sub>3</sub>O<sub>4</sub> to form three compounds, **A**, **B** and **C**.

- **A** is iron(II) sulfate.
- **B** is iron(III) sulfate.
- **C** is a colourless liquid.

(i) Name compound **C**.

.....[1]

(ii) Construct the equation for this reaction.

.....[2]

(iii) Describe a chemical test for iron(III) ions.

test .....

observation .....

.....

5070/8&&/A />/1, #Q&

30 The transition elements occupy the central block of the Periodic Table.

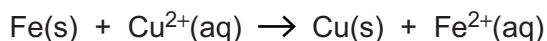
Iron and copper are typical transition elements.

(a) The compounds of transition elements are often coloured.

What is the colour of iron(III) hydroxide?

.....[1]

(b) A redox reaction happens when iron filings are added to aqueous copper(II) sulfate.



(i) Describe what is observed during this reaction.

.....

.....[2]

STUDENTS RESOURCE

5070/88/A/1, #Q,

31 Calcium carbonate reacts with dilute nitric acid to form three compounds, X, Y and Z.

- X is a salt.
- Y is a colourless gas.
- Z is a colourless liquid.

(i) Name Y and describe a test for this gas.

name .....

test .....

observation .....

[2]

(ii) Name Z and describe a chemical test for this liquid.

name .....

chemical test .....

observation .....

[2]

(iii) Construct the equation for the reaction between calcium carbonate and nitric acid.

.....[1]

5070/8/C/B/18#Q&

32 Aqueous ammonia is added, with mixing, to a solution containing zinc ions until no further change occurs.

What observations would be made during this test?

.....

.....

.....[2]

5070/8/C/B/18#Q&

33 What observations are made when adding aqueous ammonia to a solution containing copper(II) ions, slowly with mixing, until no further change occurs?

.....

.....

.....[2]

STUDENTS RESOURCE

**5070/88/A/1/10 #Q+**

34 Describe a chemical test for the iodide ion.

test .....

observation .....

..... [2]

**5070/89/C/B/1/10 #Q&**

35 Sodium chloride is an ionic compound which is a solid at room temperature. It is soluble in water.

(iii) Describe a test for chloride ions.

test .....

observation .....

[2]

**5070/89/A/1/10 #Q-**

36 Describe a chemical test that can be used to distinguish between aqueous solutions of iron(II) sulfate and iron(III) sulfate.

chemical test .....

result with iron(II) sulfate .....

result with iron(III) sulfate .....

[2]

**5070/88/A/1/10 #Q-**

3+ Describe the chemical test for sulfur dioxide.

test .....

observation .....

[2]

STUDENTS RESOURCE

5070/88/A/1/8/Q

3, In an experiment  $C_{10}H_{22}$  is cracked to form products **A**, **B** and **C**.

(i) Product **A** gives a squeaky pop when ignited with a burning splint.

Identify product **A**.

..... [1]

5070/8/C/B/8/Q

' - This question is about copper and copper compounds.

(b) Describe a test for copper(II) ions.

test .....

observations .....

[2]

5070/8/C/B/8/Q'

4\$ In the past, ink was made from a mixture containing iron(II) ions and tannic acid.

(i) Describe a test for iron(II) ions.

test .....

observations .....

[2]

5070/21/M/J/21/Q1(f)

4% (a) Acidified aqueous silver nitrate reacts with aqueous sodium iodide.

State the observations for this reaction.

..... [1]

5070/22/O/N/21/Q2b

4& (a) Describe a test for carbon dioxide.

test .....

observation .....

[2]

STUDENTS RESOURCE