



Salt /Garam

A. Definition of Salt / Definasi Garam

An ionic compound formed when the **hydrogen ion, H⁺** from an acid is replaced by a **metal ion** or an **ammonium ion, NH₄⁺**

B. Four type of Salt / Empat jenis garam

(I) Nitrate / Nitrat	(II) Chloride / Klorida
{formula ion} NO₃⁻, anion NO₃⁻	{formula ion} Cl⁻, anion Cl⁻
(III) Sulphate	(IV) Carbonate
{formula ion} SO₄²⁻, anion SO₄²⁻	{formula ion} CO₃²⁻, anion CO₃²⁻

C. Solubility of Salts in Water / Keterlarutan Garam Di Dalam Air

No Bil	Salt Garam	Soluble in water Keterlarutan di dalam air	Memorise Note
		All Potassium, K ⁺ , Sodium, Na ⁺ and Ammonium, NH ₄ ⁺ salt dissolve <i>Semua garam Kalium, K⁺, Natrium, Na⁺ dan Ammonium, NH₄⁺ larut</i>	SPA
1	Nitrate Nitrat	All Soluble <i>Semua larut</i>	
2	Chloride Klorida	All soluble except PbCl₂, AgCl and HgCl <i>Semua larut kecuali PbCl₂, AgCl dan HgCl</i>	coPAgMer
3	Sulphate Sulfat	All soluble except BaSO₄, CaSO₄ and PbSO₄ <i>Semua larut kecuali BaSO₄, CaSO₄ dan PbSO₄</i>	suBaCaPb
4	Carbonate Karbonat	All carbonate salt insoluble except K, Na and NH ₄ carbonate <i>Semua garam karbonat TIDAK Larut Kecuali K, Na dan NH₄ karbonat</i>	

Note /Nota !

Salt – divide to 2 / Garam – dibahagikan kepada 2:

(i) Soluble salt / Garam Terlarutkan (ii) Insoluble Salt Garam Tak Terlarutkan

Soluble salt is salt soluble in **water at room temperature.**

Garam terlarutkan ialah garam **yang larut dalam air pada suhu bilik.**

1. [SBPdiag06-07] Which of the following best defines the term 'salt'?

- A Formed when a hydrogen ion in an acid is replaced by a metal ion or ammonium ion
- B Formed when a metal ion reacts with a non-metal ion
- C That contains sodium ions and chloride ions
- D It is salty in taste

2. [MRS07-08] A salt always ...

- A contains ions
- B dissolves in water
- C forms white crystals
- D conducts electricity

3. [MRS05-12] Which of the following salts is water soluble?

- A Calcium sulphate
- B Silver chloride
- C Sodium carbonate
- D Lead(II) sulphate

4. [MRS07-07] Which of the following salt is soluble in water?

- A Iron(II) sulphate
- B Silver chloride
- C Calcium carbonate
- D Lead(II) bromide

5. [TrialsBP07-07] Which of the following is a soluble salt?

- A Lead(II) iodide
- B Copper(II) carbonate
- C Barium sulphate
- D Sodium hypochlorite

6. [TrialsBP07-21] Nitric acid will change to nitrate salt when hydrogen ions are replaced by

- I copper ion
- II hydroxide ion
- III carbonate ion
- IV ammonium ion

- A I and II only
- B I and IV only
- C II and IV only
- D I, III and IV only

7. [TrialsBP08-07] Which of the following compounds is a soluble salt?

- A Lead(II) iodide
- B Barium sulphate
- C Calcium chloride
- D Magnesium carbonate

8. [SBPdiag07-05] Among the following salts, which is soluble in water?

- A Barium sulphate
- B Lead(II) chloride
- C Zinc carbonate
- D Lead(II) nitrate

9. [SBPdiag08-07] Which of the following statements is correct?

- A All carbonate salts are soluble in water
- B All chloride salts are soluble in water
- C All nitrate salts are soluble in water
- D All sulphate salts are soluble in water

10. [MRS04-03] The following salts are soluble except

- A copper(II) carbonate
- B copper(II) nitrate
- C copper(II) chloride
- D copper(II) sulphate

D. PREPARATION OF SALT / PENYEDIAAN GARAM**a. Preparation of insoluble salt (Double Decomposition)***Penyediaan Garam Tak Terlarutkan (Penguraian Ganda Dua)***Method / Kaedah:****1. Must used 2 soluble salt***MESTI menggunakan 2 larutan garam terlarutkan***2. One MUST contain positive ion that wanted –(MUST have Pb²⁺ ion)***SATU MESTI mengandungi ion positif yang dimahukan (MESTI ADA ion Pb²⁺)**- Example / Contoh : Pb(NO₃)₂***3. One more MUST contain negative ion that wanted (– MUST have Cl⁻ ion)***SATU MESTI mengandungi ion negatif yang dimahukan (MESTI ADA ion Cl⁻)**- Example / Contoh: NaCl***4. Then mix the 2 solution, the exchange pairs of ion will happen***Kemudian campurkan 2 larutan tersebut, akan berlaku pertukaran pasangan ion-ionnya**- know as **Double Decomposition**
dikenali sebagai Penguraian Ganda Dua**-Pb²⁺ ion combines with Cl⁻ ion to form solid PbCl₂**ion Pb²⁺ bergabung dengan ion Cl⁻ membentuk pepejal PbCl₂**- Na⁺ ion combines with NO₃⁻ ion to form NaNO₃ as solution**ion Na⁺ bergabung dengan ion NO₃⁻ membentuk larutan NaNO₃***Example for preparation for insoluble salt:***Contoh penyediaan garam tak terlarutkan:*

(i). Lead (II) chloride / Plumbum(II) klorida, PbCl₂	
Pb(NO₃)₂ + 2NaCl → PbCl₂ + 2NaNO₃	
Pb(NO₃)₂ + 2KCl → PbCl₂ + 2KNO₃	
Pb(NO₃)₂ + 2NH₄Cl → PbCl₂ + 2NH₄NO₃	
(ii). Silver Chloride, Argentum klorida AgCl	
AgNO₃ + NaCl → AgCl + NaNO₃	
Ag₂SO₄ + 2KCl → 2AgCl + K₂SO₄	
Exercise:	
(i). Barium sulphate, <i>Barium sulfat BaSO₄</i>	(ii). Lead (II) Sulphate, <i>Plumbum (II) Sulfat PbSO₄</i>
BaCl₂ + K₂SO₄ → BaSO₄ + 2KCl	Pb(NO₃)₂ + K₂SO₄ → PbSO₄ + 2KNO₃
Ba(NO₃)₂ + Na₂SO₄ → BaSO₄ + 2NaNO₃	
(iii). Copper Carbonate, <i>Kuprum Karbonat CuCO₃</i>	(iv). Magnesium Carbonate, <i>Magnesium Karbonat MgCO₃</i>
Cu(NO₃)₂ + K₂CO₃ → CuCO₃ + 2KNO₃	MgCl₂ + K₂CO₃ → MgCO₃ + 2KCl
	Mg(NO₃)₂ + Na₂CO₃ → MgCO₃ + 2NaNO₃
	MgSO₄ + K₂CO₃ → MgCO₃ + K₂SO₄

1. [SBPdiag08-15] Insoluble salts can be prepared through

- A Precipitation Reaction
 B Neutralization Reaction
 C Crystallization
 D Recrystallisation

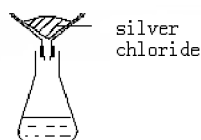
2. [SBPmidYearF5-11] What is precipitation reaction?

- A One aqueous soluble salt and one insoluble salt are mixed to form an insoluble salt.
 B One aqueous soluble salt and one insoluble salt are mixed to form soluble salt.
 C Two different aqueous soluble salts are mixed to form an insoluble salt
 D Two different aqueous soluble salts are mixed to form soluble salt.

3. [MRSM07-07] Lead(II) iodide is formed when aqueous lead(II) nitrate is added to a solution containing iodide ions. What type of reaction takes place?

- A Neutralisation
 B Oxidation
 C Reduction
 D Precipitation

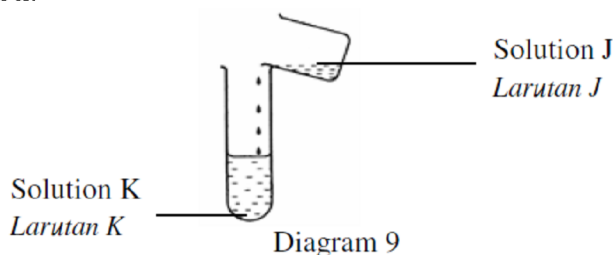
4. [MRSM04-05] Figure 3 shows the apparatus set – up for the separation of silver chloride salt from the mixture of reaction products.



Which of the following reactants is most suitable for the preparation of silver chloride?

- A Silver and hydrochloric acid
 B Aqueous silver nitrate and aqueous sodium chloride
 C Solid silver carbonate and hydrochloric acid
 D Aqueous silver nitrate and sodium hydroxide

5. [MRSM09-27] Diagram 9 shows the formation of a white precipitate when solution J and solution K are mixed.



Which of the following is the most suitable to be solution J and solution K?

- I Sodium sulphate and lead (II) nitrate
 II Sodium chloride and aluminium nitrate
 III Sodium chloride and silver nitrate
 IV Sodium nitrate and calcium chloride
- A I and II
 B I and III
 C II and III
 D II and IV

b. Reaction for preparation soluble salt / Penyediaan garam Terlarutkan

No	Type of reaction / Jenis Tindak balas	Example (Please Complete)
1	<p>Reaction acid with metal (follow the reactivity series – the metal more reactive than hydrogen) Product : Salt, release hydrogen gas <i>Tindak balas asid dengan logam</i> (mengikut Siri Elektrokimia – logam yang lebih elektropositif dari hidrogen) Hasil : Garam, membebaskan gas hydrogen</p>	<p>$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$ $\text{Cu} + \text{H}_2\text{SO}_4 \rightarrow \text{no reaction}$</p>
2	<p>Reaction acid with oxide metal Product : Salt and Water <i>Tindak balas asid dengan oksida logam</i> Hasil : Garam dan air</p>	<p>$\text{CuO} + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O}$</p>
3	<p>Reaction acid with metal carbonate Product : Salt, water and carbon dioxide gas <i>Tindak balas asid dengan logam karbonat</i> Hasil : Garam, air dan gas karbon dioksida</p>	<p>$\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$</p>
4	<p>Neutralization reaction (Acid with Alkali) Product : Salt and Water <i>Tindak balas Peneutralan</i> (Asid dengan Alkali) Hasil : Garam dan air</p>	<p>$\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$</p>






c. Preparation of Soluble Salt / Penyediaan Garam Terlarutkan**1. Construct the GaRAK-1 - Symbol for experiment to prepare soluble salt:**

GaRAK-1 – Simbol bagi eksperimen Penyediaan Garam Terlarutkan

[For Potassium, K, Sodium, Na and ammonium, NH₄ – Titration Method][Untuk Kalium, K, Natrium, Na dan ammonium, NH₄ – Kaedah Pentitratan]

[Acid with Alkali]

[Asid dengan Alkali]

Diagram Rajah	Symbol Simbol	Explanation Penerangan
	+	Titrate the solution [acid and alkali] <i>Titratkan 2 larutan [asid dan alkali]</i>
	E	Evaporate the solution until saturated <i>Panaskan larutan sehingga tepu/ tinggal 1/3</i>
	C	Cool the solution at room temperature for crystallisation <i>Sejukkan larutan pada suhu bilik untuk pembentukan kristal</i>
	Y	Filter the mixture <i>Turaskan campuran</i>
	O	Rinse a little with distil water and dry using filter paper <i>Basuh dengan sedikit air suling dan keringkan dengan kertas turas</i>







2. Construct the GaRAK-2 - Symbol for experiment to prepare soluble salt:

GaRAK-2 – Simbol bagi eksperimen Penyediaan Garam Terlarutkan

[For **other than** Potassium, K, Sodium, Na and ammonium, NH₄][Selain Kalium, K, Natrium, Na dan ammonium, NH₄]




[Acid with metal] [Acid with metal oxide] [Acid with metal carbonate]

[Asid dengan logam] [Asid dengan logam oksida] [Asid dengan logam karbonat]

Diagram Rajah	Symbol Simbol	Explanation Penerangan
	+	<p>Heat acid <i>Panaskan asid</i></p> <p>Add bit by bit <i>tambah sedikit demi sedikit</i></p> <p>Stir the solution <i>Kacau larutan</i></p> <p>Add until excess <i>Tambah sehingga berlebihan</i></p>
	Y	<p>Filter to remove excess or residue <i>Turaskan untuk membuang lebihan</i></p>
	E	<p>Evaporate the solution until saturated <i>Panaskan larutan sehingga tepu/ tinggal 1/3</i></p>
	C	<p>Cool the solution at room temperature for crystallisation <i>Sejukkan larutan pada suhu bilik untuk pembentukan Kristal</i></p>
	Y	<p>Filter the mixture <i>Turaskan campuran</i></p>
	O	<p>Rinse a little with distil water and dry using filter paper <i>Basuh dengan sedikit air suling dan keringkan dengan kertas turas</i></p>

3. Construct the GaRAK-3 - Symbol for experiment to prepare insoluble salt:

GaRAK-3 - Simbol bagi eksperimen Penyediaan Garam Tak Terlarutkan

Diagram Rajah	Symbol Simbol	Explanation Penerangan
	+	Add two solution of soluble salt <i>Tambahkan 2 larutan garam terlarutkan</i>
	Y	Filter the mixture <i>Turaskan campuran</i>
	O	Rinse a little with distil water and dry using filter paper <i>Basuh dengan sedikit air suling dan keringkan dengan kertas turas</i>

d. Example using GaRAK :

The chemicals supplied are

- Zinc oxide
- Sodium carbonate solution
- Dilute nitric acid

Describe briefly how you can prepare a sample of dry zinc carbonate in the laboratory. Include in your answer all chemical equations involved.

Explanation:

1. Zinc carbonate is insoluble salt. -- > Preparation Insoluble Salt.

-- > must use two soluble salt solution

2. How to get soluble salt?

-- > reaction Acid with

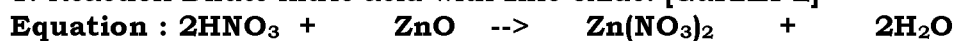
--> Metal

--> Metal Oxide [Zinc oxide]

--> Metal Carbonate [Sodium Carbonate. Cannot because its solution]

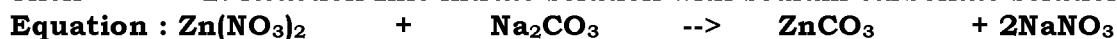
Answer:

1. Reaction Dilute nitric acid with zinc oxide. **[GaRAK-2]**



Symbol	Explanation
	1.
+	2.
	3.
	4.
Y	5.
E	6.
C	7.
Y	8.
	[Then we get the zinc nitrate solution. We will use in next step]
O	[This step no need, because we want the solution. Not a dry salt]

Then 2. Reaction zinc nitrate solution with sodium carbonate solution



Symbol	Explanation
+	1.
Y	2.
O	3.

NOTE ! MUST State the concentration and volume of solution.

Example: **20 cm³** of **0.001 mol dm⁻³** nitric acid was poured into **200 cm³ beaker** and heat.

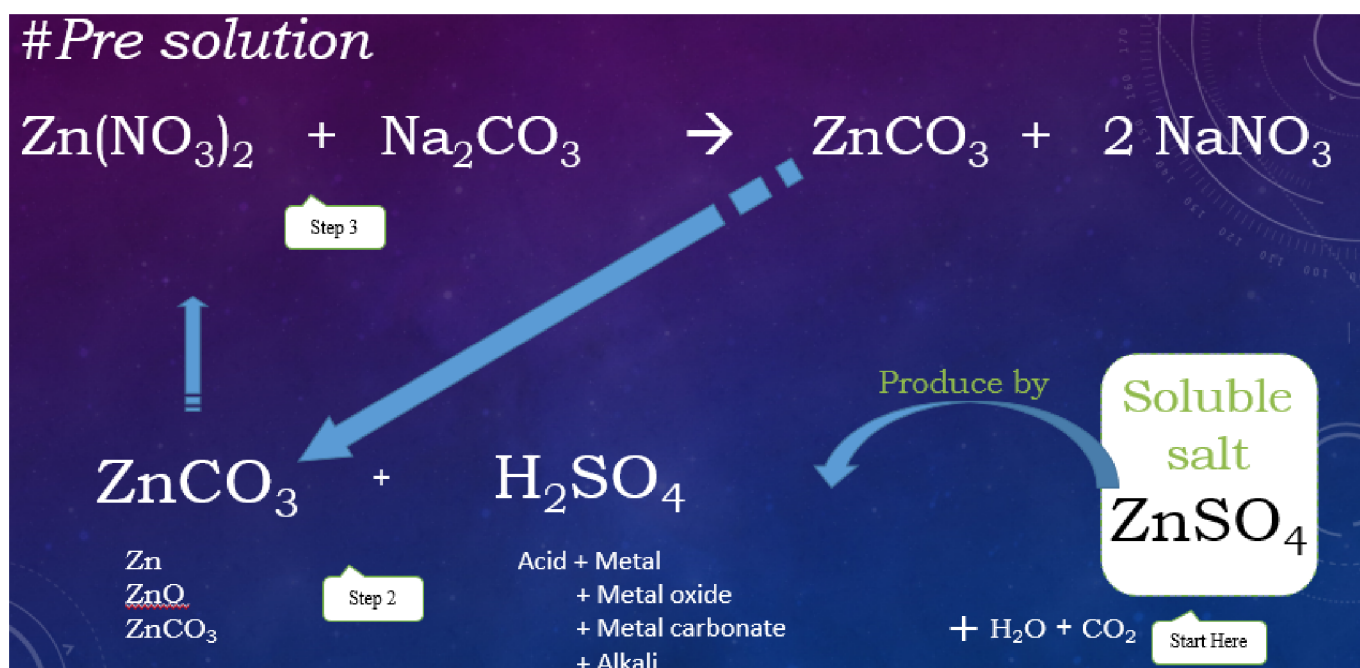
e. Exercise / Latihan :

1. You are required to prepare dry zinc sulphate salt. The chemicals supplied are
Anda dikehendaki menyediakan garam zink sulfat kering. Bahan kimia yang dibekalkan ialah:

- Zinc Nitrate Solution *Larutan Zink Nitrat*
- Dilute Sulphuric Acid *Asid sulfurik cair*
- Sodium Carbonate Solution *Larutan natrium Karbonat*

Describe a laboratory experiment to prepare the salt. In your description, include chemical equations involved.

Huraikan eksperimen makmal untuk menyediakan garam tersebut. Dalam penerangan anda, masukkan persamaan kimia yang terlibat.



#write the answer

Chemical Equation

1. 100 cm³ of 1.0 mol dm⁻³ zinc nitrate solution was poured into 100 cm³ of 1.0 mol dm⁻³ sodium carbonate solution in 250 cm³ of beaker. The mixture was stir.
2. After that, the mixture was filter.
3. The residue is zinc carbonate.

Chemical Equation

4. 100 cm³ of dilute sulphuric acid solution was heated in 250 cm³ of beaker.
5. Then zinc carbonate powder was add bit by bit into 100 cm³ of dilute sulphuric acid.
6. The mixture was stir.
7. Continue adding zinc carbonate until excess.

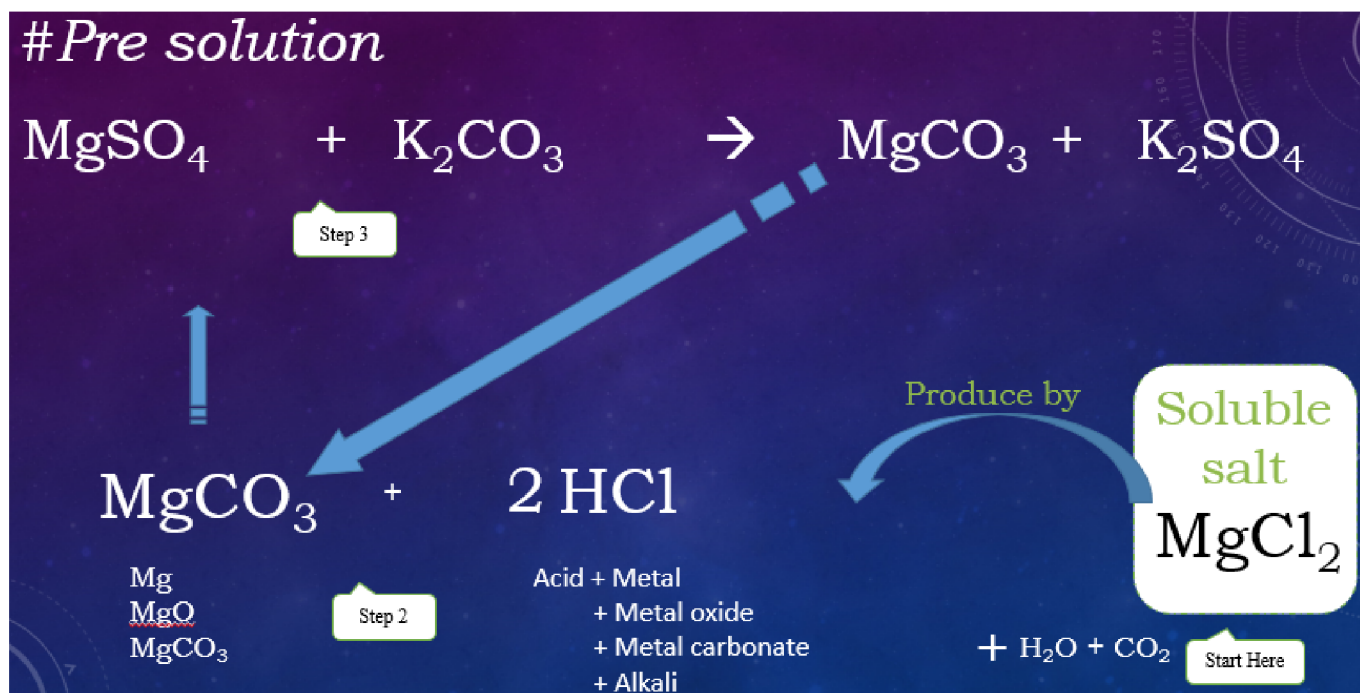
8. After that, filter the mixture to remove excess of zinc carbonate. The filtrate is zinc sulphate.
9. Transfer it into evaporating dish and heat the evaporating dish until the solution was saturated.
10. Then leave the solution to cool at room temperature for crystallisation process.
11. After that, filter the mixture. The residue is Zinc sulphate.
12. Rinse a little distil water onto zinc sulphate and dried it by using filter paper.

2. You are required to prepare dry magnesium chloride salt. The chemicals supplied are:
Anda dikehendaki menyediakan garam magnesium klorida kering. Bahan kimia yang dibekalkan ialah:

- Magnesium Sulphate Solutions *Larutan Magnesium Sulfat*
- Dilute Hydrochloric Acid *Asid hidrokloric cair*
- Potassium Carbonate Solution *Larutan kalium Karbonat*

Describe a laboratory experiment to prepare the salt. In your description, include the chemical equation involved.

Huraikan eksperimen makmal untuk menyediakan garam tersebut. Dalam penerangan anda, masukkan persamaan kimia yang terlibat.



#write the answer

Chemical Equation : $\text{MgSO}_4 + \text{K}_2\text{CO}_3 \rightarrow \text{MgCO}_3 + \text{K}_2\text{SO}_4$

1. 100 cm³ of 1.0 mol dm⁻³ magnesium sulphate solutions was poured into 100 cm³ of 1.0 mol dm⁻³ Potassium Carbonate Solution in 250 cm³ of beaker. The mixture was stir.
2. After that, the mixture was filter.
3. The residue is magnesium carbonate.

Chemical Equation : $\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

4. 100 cm³ of dilute hydrochloric acid was heated in 250 cm³ of beaker.
5. Then magnesium carbonate powder was add bit by bit into 100 cm³ of dilute hydrochloric acid.
6. The mixture was stir.
7. Continue adding magnesium carbonate until excess.
8. After that, filter the mixture to remove excess of magnesium carbonate. The filtrate is Magnesium chloride.
9. Transfer it into evaporating dish and heat the evaporating dish until the solution was saturated.

10. Then leave the solution to cool at room temperature for crystallisation process.
11. After that, filter the mixture. The residue is Magnesium chloride.
12. Rinse a little distil water onto magnesium chloride and dried it by using filter paper.

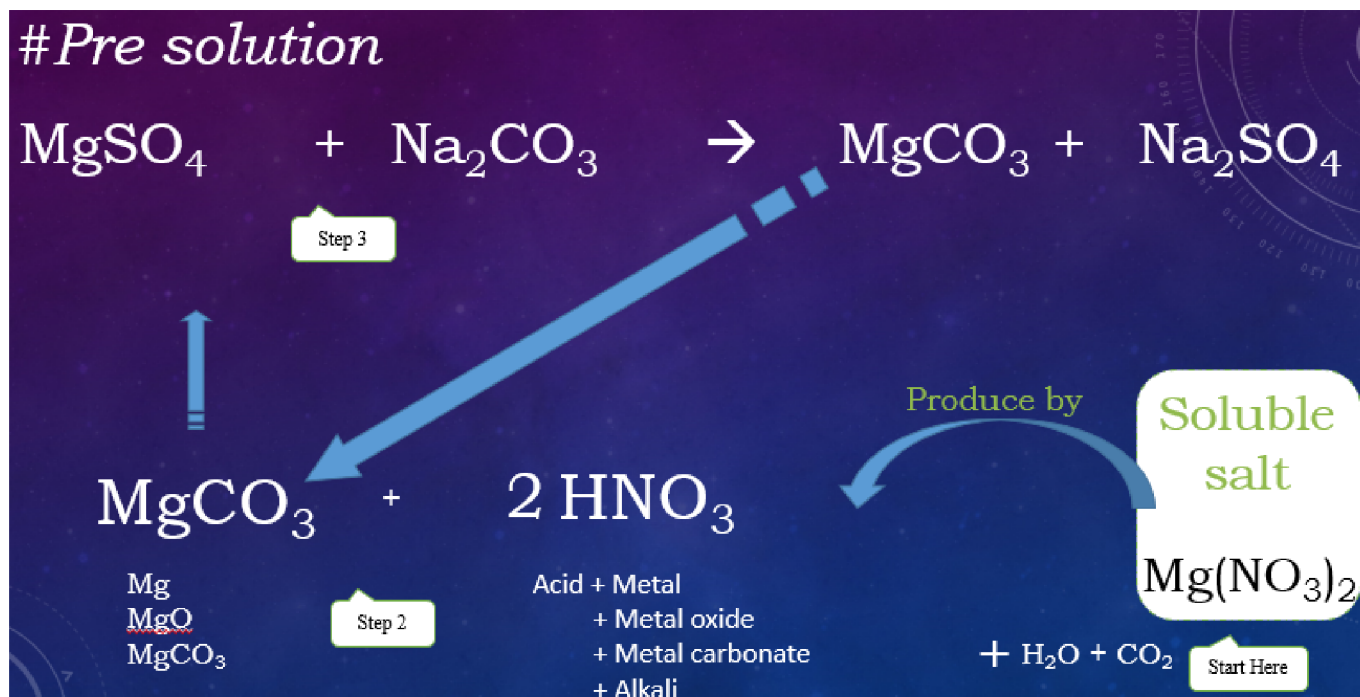
3. You are required to prepare magnesium nitrate salt from the chemical substances provided below.

Anda dikehendaki menyediakan garam magnesium nitrat kering. Bahan kimia yang dibekalkan ialah:

- Magnesium sulphate solution *Larutan Magnesium sulfat*
- Dilute nitric acid *Asid nitrit cair*
- Sodium carbonate solution *Larutan natrium karbonat*

Your answer should include all the chemical equations involved in the reactions.

Huraikan eksperimen makmal untuk menyediakan garam tersebut. Dalam penerangan anda, masukkan persamaan kimia yang terlibat.



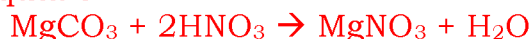
#write the answer

Chemical Equation



1. 100 cm³ of 1.0 mol dm⁻³ magnesium sulphate solutions was poured into 100 cm³ of 1.0 mol dm⁻³ sodium Carbonate Solution in 250 cm³ of beaker. The mixture was stir.
2. After that, the mixture was filter.
3. The residue is magnesium carbonate.

Chemical Equation



4. 100 cm³ of dilute hydrochloric acid was heated in 250 cm³ of beaker.
5. Then magnesium carbonate powder was add bit by bit into 100 cm³ of dilute hydrochloric acid.
6. The mixture was stir.
7. Continue adding magnesium carbonate until excess.
8. After that, filter the mixture to remove excess of magnesium carbonate. The filtrate is Magnesium nitrate.

9. Transfer it into evaporating dish and heat the evaporating dish until the solution was saturated.
10. Then leave the solution to cool at room temperature for crystallisation process.
11. After that, filter the mixture. The residue is Magnesium nitrate.
12. Rinse a little distil water onto Magnesium nitrate and dried it by using filter paper.

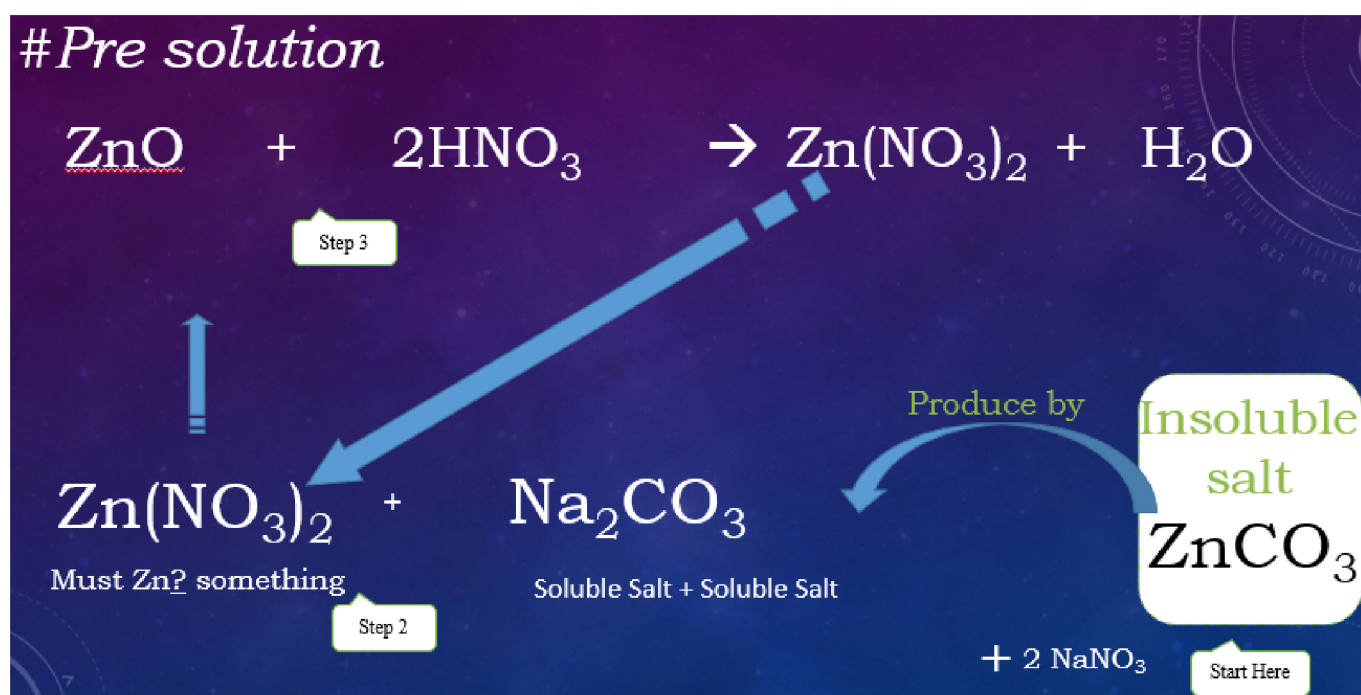
Extra Exercise /Latihan Tambahan :

1. You are required to prepare dry pure zinc carbonate salt. The chemicals supplied are
Anda dikehendaki menyediakan garam zink karbonat kering. Bahan kimia yang dibekalkan ialah:

- Zinc oxide powder / *Serbuk Zink oksida*
- Dilute nitric acid / *Asid nitrit cair*
- Sodium carbonate solution / *Larutan natrium karbonat*

Describe a laboratory experiment to prepare the salt. In your description, include the chemical equations involved.

Huraikan eksperimen makmal untuk menyediakan garam tersebut. Dalam penerangan anda, masukkan persamaan kimia yang terlibat.



Chemical Equation : $\text{ZnO} + 2 \text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{H}_2\text{O}$

1. 100 cm³ of dilute nitric acid solution was heated in 250 cm³ of beaker.
2. Then zinc oxide powder was add bit by bit into 100 cm³ of dilute nitric acid.
3. The mixture was stir.
4. Continue adding zinc oxide until excess.
5. After that, filter the mixture to remove excess of zinc oxide. The filtrate is zinc nitrate.

Chemical Equation : $\text{Zn}(\text{NO}_3)_2 + \text{Na}_2\text{CO}_3 \rightarrow \text{ZnCO}_3 + 2\text{NaNO}_3$

6. 100 cm³ of 1.0 mol dm⁻³ zinc nitrate solution was poured into 100 cm³ of 1.0 mol dm⁻³ sodium carbonate solution in 250 cm³ of beaker. The mixture was stir.
7. After that, the mixture was filter.
8. The residue is zinc carbonate. Dry using 2 filter paper

E : Confirmatory Test Ujian Pengesahan**a. Physical state (colour) Keadaan Fizikal (Warna)****(I). Oxide Metal Name Oksida Metal Name**

	Metal Oxide Name <i>Metal Oksida Name</i>	Colour (HOT) <i>Warna (PANAS)</i>	Colour (COOL/ ROOM TEMPERATURE) <i>Warna (SEJUK/ SUHU BILIK)</i>
1	Copper (II) Oxide, CuO <i>Kuprum(II) Oksida, CuO</i>	Black	Black
2	Lead (II) Oxide, PbO <i>Plumbum (II) Oksida, PbO</i>	Brown	Yellow
3	Zink Oxide, ZnO <i>Zink Oksida, ZnO</i>	Yellow	White
4	Other Metal Oxide (NORMAL) <i>Logam oksida lain (NORMAL)</i>	White	White

(II). Salt Colour Warna Garam

	Salt Name <i>Nama Garam</i>	Colour <i>Warna</i>	State <i>Fizikal</i>
1	Copper (II) carbonate, CuCO ₃ <i>Kuprum(II) karbonat, CuCO₃</i>	Green	Solid
2	Copper (II) Chloride, Nitrate, Sulphate <i>Kuprum(II) Klorida, Nitrat, Sulfat</i>	Blue	Liquid
3	Iron / Ferum (II)	Green	Liquid
4	Iron / Ferum (III)	Brown	Liquid/solid
5	Other salt <i>Garam Lain</i>	White	

b. Action of heat on salts Tindak balas garam terhadap haba

No	Type of Salt <i>Jenis Garam</i>	Product of reaction (General) <i>Hasil tindak balas (Umum)</i>
1	Carbonate Salt <i>Karbonat</i>	Oxide metal and CO ₂ gas <i>Logam oksida dan gas CO₂</i>
2	Nitrate Salt <i>Nitrat</i>	Oxide metal, Nitrogen dioxide (brown) and O ₂ gas <i>Logam oksida, Nitrogen dioksida (Perang) dan gas O₂</i>
3	Sulphate Salt <i>Sulfat</i>	CANNOT DECOMPOSE except Zinc sulphate, Copper sulphate and iron (III) sulphate produce oxide metal and sulfur trioxide gas <i>TIDAK mengurai kecuali Zink sulfat, Zink sulfurik dan ferum(III) sulfat menghasilkan logam oksida dan gas sulfur trioksida</i> Ammonium sulphate salt release ammonia and steam of acid sulphuric <i>Garam Ammonium sulfat membebaskan gas ammonia dan wap asid sulfurik.</i>
4	Chloride Salt <i>Klorida</i>	CANNOT DECOMPOSE except ammonium chloride release ammonia and hydrogen chloride gas <i>TIDAK mengurai kecuali ammonium klorida membebaskan gas ammonia dan hidrogen klorida</i>

Note / Nota !

Substance / Bahan	Colour / Warna	Physical state / Keadaan fizikal
Copper <i>Kuprum</i>	Brown	Solid
Copper(II) Oxide <i>Kuprum(II) Oksida</i>	Black	Solid
Copper(II) Carbonate <i>Kuprum(II) karbonat</i>	Green	Solid
Copper solution <i>Larutan kuprum</i>	Blue	solution
Copper(II) Nitrate <i>Kuprum(II) nitrat</i>		
Copper(II) Chloride <i>Kuprum(II) klorida</i>		
Copper(II) Sulphate <i>Kuprum(II) sulfat</i>		

1. [SBPdiag07-40] Which of the following compound is wrongly matched to its colour?

	Compound	Colour
A	Copper(II) nitrate	Reddish
B	Copper(II) sulphate	Blue
C	Copper(II) carbonate	Green
D	Copper(II) oxide	Black

2. [SBPdiag06-39] A metal carbonate, XCO_3 , is green in colour. When it is heated strongly, the remaining solid is black. Which of the following metals could be X?

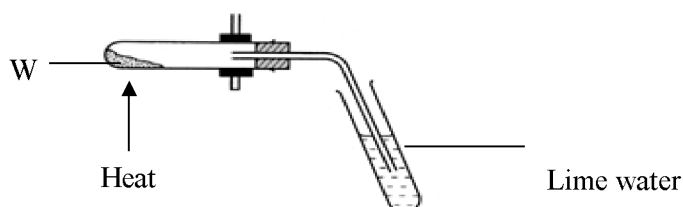
A	Zinc	B	Lead
C	Copper	D	Aluminium

3. [SBPdiag07-10] A green solid is heated up strongly and the residue is black in colour. The solid is

A	Sodium carbonate	B	Lead(II) nitrate
C	Iron(II) carbonate	D	Copper(II) carbonate

4. [TrailSBP09-20] Diagram 7 shows the set up of the apparatus for the action of heat on substance W.

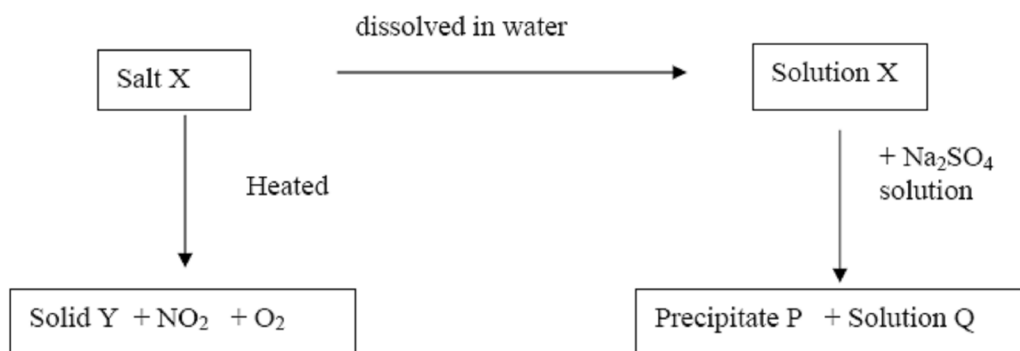
After a few minutes lime water turns cloudy.



Which of the following salts could be W?

- | | | | |
|-----|----------------------|----------|---------------------|
| I | Lead(II) nitrate | II | Zinc carbonate |
| III | Copper(II) carbonate | IV | Potassium carbonate |
| A | I and IV | B | II and III |
| C | I, II and III | D | II, III and IV |

5. [MRSM05-43] The flow chart shows the analysis process of salt X. The heating of salt X yields residue Y that is brown when hot and turns yellow when cold.



Which of the following pairs represent solid Y and precipitate P?

	Solid Y	Precipitate P
A	Lead(II) oxide	Lead(II) sulphate
B	Zinc oxide	Zinc nitrate
C	Zinc oxide	Zinc sulphate
D	Lead(II) oxide	Lead(II) nitrate

6. [MRSM09-42] Diagram 16 shows the observations of an experiment conducted on solution Z.

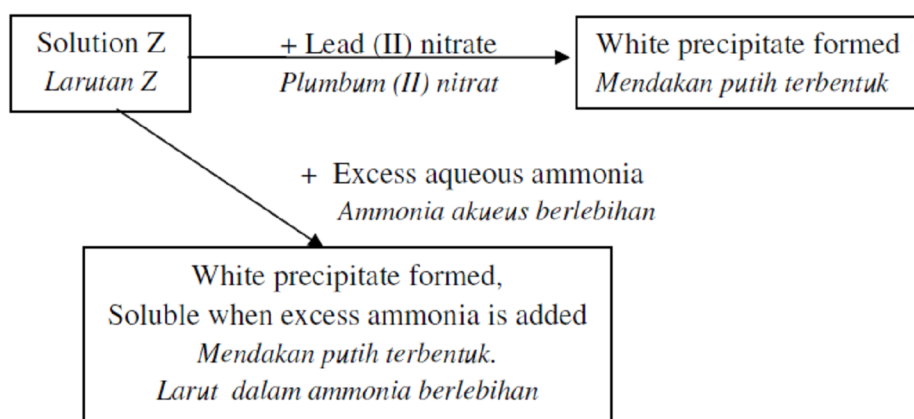


Diagram 16

From the observations, Z could be

- | | | | |
|----------|----------------------|---|--------------------|
| A | zinc sulphate | B | calcium chloride |
| C | magnesium nitrate | D | aluminium sulphate |

7. [MRSO3-30]

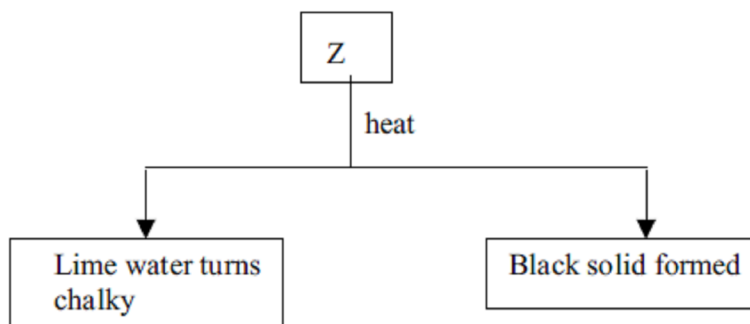
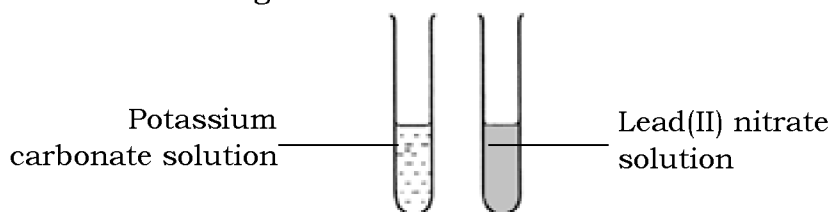


Figure 7

Figure 7 shows the results of the action of heat on solid Z. Which of the following represents solid z?

- A Magnesium carbonate
 C Magnesium nitrate
 B Copper carbonate
 D Copper nitrate

8. [TrailSBP07-33] The diagram below shows the test tubes containing lead(II) nitrate solution and potassium carbonate solution but without a label. Which of the following solutions can be used to distinguish both solutions?



- I Sodium nitrate
 III Dilute nitric acid
 II Sodium iodide
 IV Potassium sulphate
 A I and II only
 C II, III and IV only
 B II and IV only
 D I, II, III and IV

9. [SPM06-41] You are asked by your teacher to verify the cation and anion in a sample of ammonium chloride salt solution.

What substance can you use to verify the cation and anion?

- | | Cation | Anion |
|---|-----------------------|--|
| A | Nessler reagent | Dilute nitric acid and silver nitrate |
| B | Nessler reagent | Dilute hydrochloric acid and barium chloride |
| C | Potassium thiocyanate | Dilute nitric acid and silver nitrate |
| D | Potassium thiocyanate | Dilute hydrochloric acid and barium chloride |

10. [SBPmidYearF5-49] You were asked by your teacher to verify the cation and anion in a sample of iron(II) chloride salt solution.

What substance can you use to verify the cation and anion?

- | | Cation | Anion |
|---|------------------|--|
| A | Nessler reagent | Dilute nitric acid and silver nitrate |
| B | Nessler reagent | Dilute hydrochloric acid and barium chloride |
| C | Sodium hydroxide | Dilute nitric acid and silver nitrate |
| D | Sodium hydroxide | Dilute hydrochloric acid and barium chloride |

F. TEST FOR ION [CATION OR ANION]

UJIAN ION UNTUK [KATION atau ANION]

a. Test for ion : Cation I (MUST both solution)

Ujian untuk ion : Kation I (MESTI KEDUA-DUA larutan)

(I). Cation Test 1 : With Sodium hydroxide, NaOH

Ujian Kation 1 : Dengan Natrium hidroksida, NaOH

White precipitate \longrightarrow Pb^{2+} , Zn^{2+} , Al^{3+} [dissolve in excess] : **NaZAP**
 Mendakan putih Pb^{2+} , Zn^{2+} , Al^{3+} [larut dalam berlebihan]

Ca^{2+} and Mg^{2+} [not dissolve in excess]
 Ca^{2+} dan Mg^{2+} [tidak larut dalam berlebihan]

Dirty Green precipitate \longrightarrow Fe^{2+} [not dissolve in excess]
 Mendakan hijau kotor Fe^{2+} [tidak larut dalam berlebihan]

Brown precipitate \longrightarrow Fe^{3+} [not dissolve in excess]
 Mendakan perang Fe^{3+} [tidak larut dalam berlebihan]

Blue precipitate \longrightarrow Cu^{2+} [not dissolve in excess]
 Mendakan biru Cu^{2+} [tidak larut dalam berlebihan]

No precipitate \longrightarrow NH_4^+ [release gas with alkali properties, NH_3]
 tiada mendakan NH_4^+ [bebaskan gas bersifat alkali, NH_3]

(II). Cation Test 2 (Ammonia aqueous)

Ujian Kation 2 : dengan Ammonia aqueous

White precipitate \longrightarrow **Zn^{2+}** [dissolve in excess] : **AniaZie**
 Mendakan putih Zn^{2+} [larut dalam berlebihan]

Al^{3+} , Pb^{2+} and Mg^{2+} [not dissolve in excess]
 Al^{3+} , Pb^{2+} dan Mg^{2+} [tidak larut dalam berlebihan]

Dirty Green precipitate \longrightarrow Fe^{2+} [not dissolve in excess]
 Mendakan hijau kotor Fe^{2+} [tidak larut dalam berlebihan]

Brown precipitate \longrightarrow Fe^{3+} [not dissolve in excess]
 Mendakan perang Fe^{3+} [tidak larut dalam berlebihan]

Blue precipitate \longrightarrow Cu^{2+} [dissolve in excess]
 Mendakan biru Cu^{2+} [larut dalam berlebihan]

No Change \longrightarrow NH_4^+ , **Ca^{2+}**
 Tiada Perubahan NH_4^+ , Ca^{2+}

Note / NotaFor colourless salt : : Pb^{2+} , Zn^{2+} , Al^{3+} , Ca^{2+} and Mg^{2+} Untuk garam tak berwarna : Pb^{2+} , Zn^{2+} , Al^{3+} , Ca^{2+} dan Mg^{2+}

- i. Ion Zn^{2+} - **already determine** [dissolve in NaOH, dissolve in NH_3 aqueous]
 Ion Zn^{2+} - telah dikenalpasti [larut dalam NaOH, larut dalam NH_3 akues]
- ii. Ion Ca^{2+} - **already determine** [not dissolve in NaOH, no changes in NH_3 aqueous]
 Ion Ca^{2+} - telah dikenalpasti [tak larut dalam NaOH, tiada perubahan dalam NH_3 akues]
- iii. Ion Mg^{2+} - **already determine** [not dissolve in NaOH, not dissolve in NH_3 aqueous]
 Ion Mg^{2+} - telah dikenalpasti [tak larut dalam NaOH, tak larut dalam NH_3 akues]
- iv. Ion Pb^{2+} and ion Al^{3+} - not determine yet
 Ion Pb^{2+} dan ion Al^{3+} - belum dikenalpasti lagi
 [dissolve in NaOH, not dissolve in NH_3 aqueous]
 [larut dalam NaOH, tak larut dalam NH_3 akues]

Use Potassium Iodide : Al^{3+} - no changes
 Guna Kalium Iodida : Al^{3+} - Tiada Perubahan

: Pb^{2+} - Yellow precipitate, dissolve in hot water
 : Pb^{2+} - Mendakan Kuning, larut dalam air panas

(III). Confirmatory test for Cation

Ujian pengesahan bagi kation

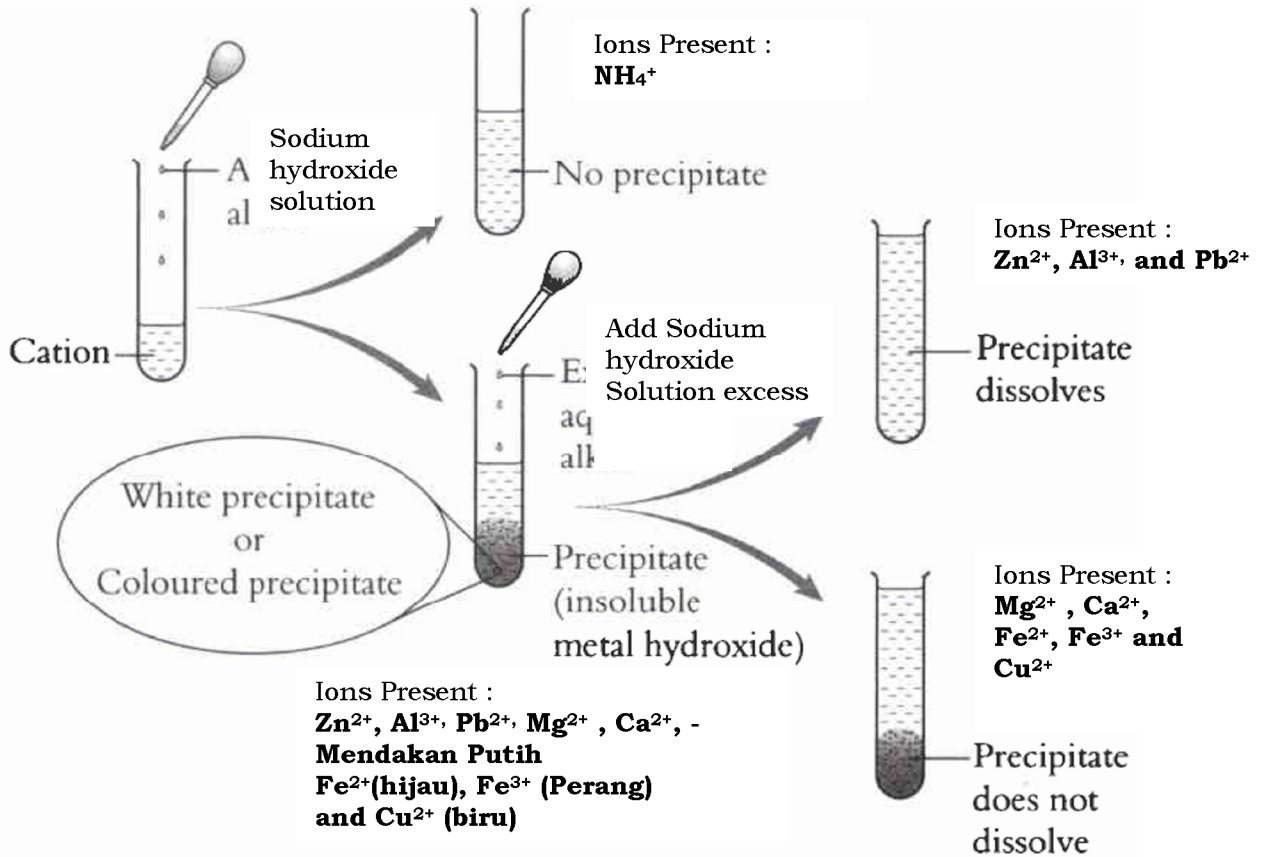
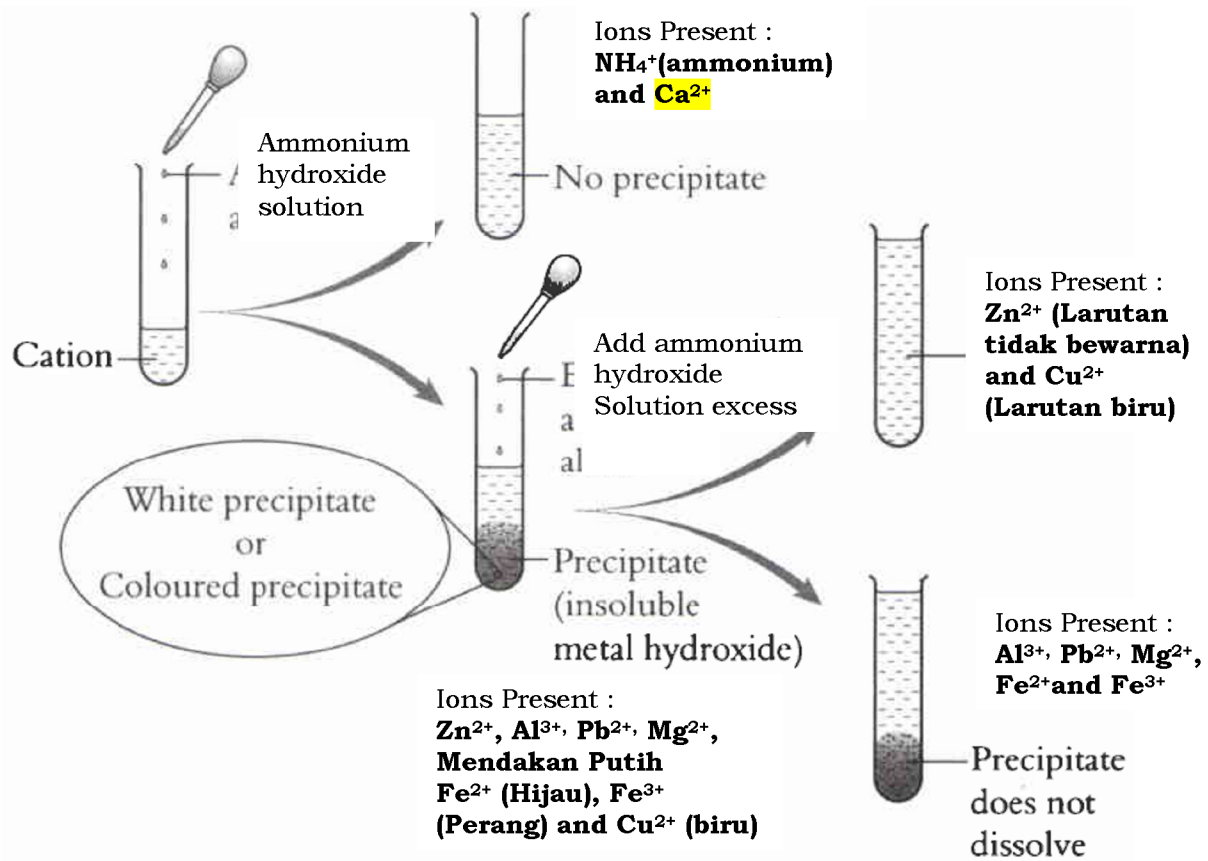
Ion	Reagan	Observation / Pemerhatian
Pb^{2+}	Potassium Iodide, KI Kalium iodida, KI	Yellow precipitate, dissolve in hot water
Fe^{2+}	Potassium hexacyanoferrate (II) Kalium hexacyanoferrate(II)	Light Blue precipitate
	Potassium hexacyanoferrate (III) Kalium hexacyanoferrate(III)	Dark blue precipitate
	Potassium thiocyanate Kalium tiosianat	No reaction
Fe^{3+}	Potassium hexacyanoferrate (II) Kalium hexacyanoferrate(II)	Dark blue precipitate
	Potassium hexacyanoferrate (III) Kalium hexacyanoferrate(III)	Brown solution
	Potassium thiocyanate Kalium tiosianat	Red blood solution

Simple to memorise for Potassium Hexacyanoferrate (II) | (III) Solution

Rngkasan untuk menghafal untuk larutan kalium hexacyanoferrate (II) | (III)

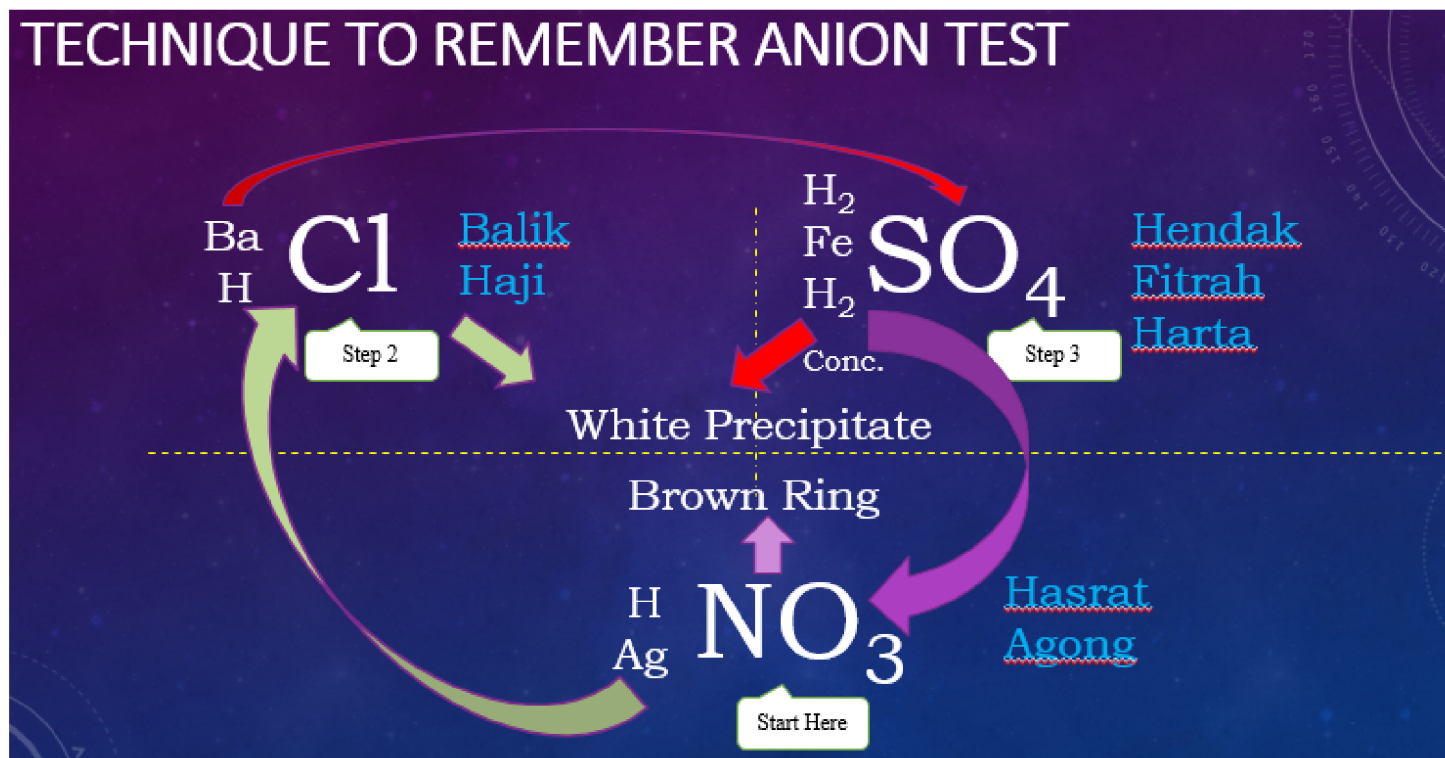
	Iron (II), Fe^{2+}	Iron (III), Fe^{3+}
Potassium hexacyanoferrate (II) Kalium hexacyanoferrate(II)	Light blue	Dark blue
Potassium hexacyanoferrate (III) Kalium hexacyanoferrate(III)	Dark blue	Brown solution

b. Test Cation with NaOH

c. Test Cation with NH_4OH 

d. Confirmatory test for Anion**d. Confirmatory test for Anion***Ujian Pengesahan Anion*

Ion	Reagan	Observation
CO ₃ ²⁻	Reaction with acid <i>Tindak balas dengan asid</i>	CO ₂ gas release and turn lime water to chalky
Cl ⁻	HNO ₃ + AgNO ₃ solution <i>Larutan HNO₃ + AgNO₃</i>	White precipitate (AgCl)
SO ₄ ²⁻	HCl + BaCl ₂ solution <i>Larutan HCl + BaCl₂</i>	White precipitate (BaSO ₄)
NO ₃ ⁻	H ₂ SO ₄ dilute + FeSO ₄ <i>H₂SO₄ cair + FeSO₄</i> - Shake then slanted - <i>Goncang kemudian senget/slanted</i> + 3 drops H ₂ SO ₄ concentrated + 3 titis H ₂ SO ₄ pekat	Brown Ring form

Technique to Remember Anion Test / *Teknik Mengingat Ujian Anion*

1. [MRS03-34]

Test	Observation
Solid K was heated	A brown gas evolved
The gas evolved was tested using damp litmus paper and glowing splint	The gas changed blue litmus paper to red The gas evolved lights up the glowing splint The residue was brown when hot, turned yellow when cold

A test to identify a solid K is carried out as in Table above. Which of the following ions may be found in solid K?

- | | | | |
|-----|-------------------------------|----------|------------------------------|
| I | Zn ²⁺ | II | Pb ²⁺ |
| III | CO ₃ ²⁻ | IV | NO ₃ ⁻ |
| A | I and III only | B | I and IV only |
| C | II and III only | D | II and IV only |

2. [MRS04-16] Which of the following ions will form precipitates that do not dissolve in excess aqueous ammonia?

- | | | | |
|-----|--------------------|----------|------------------------|
| I | Copper(II) ions | II | Aluminium ions |
| III | Lead(II) ions | IV | Zinc ions |
| A | I and IV only | B | II and III only |
| C | I, II and III only | D | II, III and IV only |

3. [MRS05-26] The table shows the observation of the experiment on solution P.

Experiment	Observation
Add sodium hydroxide solution gradually until in excess	White precipitate formed and dissolved in excess sodium hydroxide solution
Add ammonia aqueous gradually until in excess	White precipitate formed and does not dissolve in excess ammonia aqueous

Possible cations for solution P are

- | | | | |
|-----|------------------|----------|------------------------|
| I | Mg ²⁺ | II | Zn ²⁺ |
| III | Al ³⁺ | IV | Pb ²⁺ |
| A | I and II only | B | I and IV only |
| C | II and III only | D | III and IV only |

4. [MRS04-20] Excess powdered metal Z was added to aqueous copper(II) sulphate and stirred. After a few minutes, the solution turned colourless. Z could be

- | | | | |
|-----|--------------------|----------|---------------------------|
| I | Mg | II | Ag |
| III | Al | IV | Zn |
| A | I and III only | B | II and IV only |
| C | I, II and III only | D | I, III and IV only |

5. [SPM04-20] Which of the following ions form a white precipitate that dissolves in excess sodium hydroxide solution?

- | | | | |
|-----|--------------------|----|--------------------|
| I | Al^{3+} | II | Mg^{2+} |
| III | Pb^{2+} | IV | Zn^{2+} |
| A | I and II only | B | II and IV only |
| C | I, II and III only | D | I, III and IV only |

6. [TrailSBP08-18] Which of the following ions form a precipitate that dissolve in excess ammonia solution?

- | | | | |
|-----|------------------|----|--------------------|
| I | Zn^{2+} | II | Al^{3+} |
| III | Pb^{2+} | IV | Cu^{2+} |
| A | I and IV only | B | II and IV only |
| C | I and III only | D | I, II and III only |

7. [SBPdiag08-47 | SBPdiag06-46] When sodium hydroxide is added drop wise until in excess to a solution, a white precipitate which is soluble in excess is formed. The ions that could be present in the solution are

- | | | | |
|-----|--------------------|----|-------------------|
| I | Al^{3+} | II | Zn^{2+} |
| III | Mg^{2+} | IV | Pb^{2+} |
| A | I and II only | B | III and IV only |
| C | I, II, and IV only | D | I, II, III and IV |

8. [SBPdiag07-15] The table below shows the results of qualitative analysis of a salt.

Qualitative analysis	Observation
Sodium hydroxide solution is added slowly until in excess.	White precipitate formed dissolves in excess sodium hydroxide solution.
Ammonia solution is mixed slowly until in excess.	White precipitate formed does not dissolve in excess ammonia solution.

Among the following ions, which may be present in the salt?

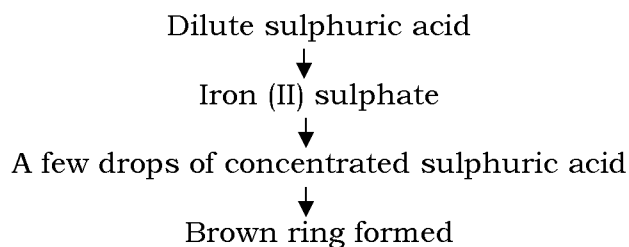
- | | | | |
|---|------------------|---|------------------|
| A | Zn^{2+} | B | Pb^{2+} |
| C | Cu^{2+} | D | Mg^{2+} |

9. [SBPmidYearF508-18] Which of the following ions form a white precipitate that does not dissolve in excess sodium hydroxide solution but no change occur in aqueous ammonia solution?

- | | | | |
|---|------------------|---|------------------|
| A | Mg^{2+} | B | Pb^{2+} |
| C | Ca^{2+} | D | Al^{3+} |

Test for Anion – Salts

1. [SBPdiag06-23] The diagram shows steps taken to test the presence of ion in the solution K



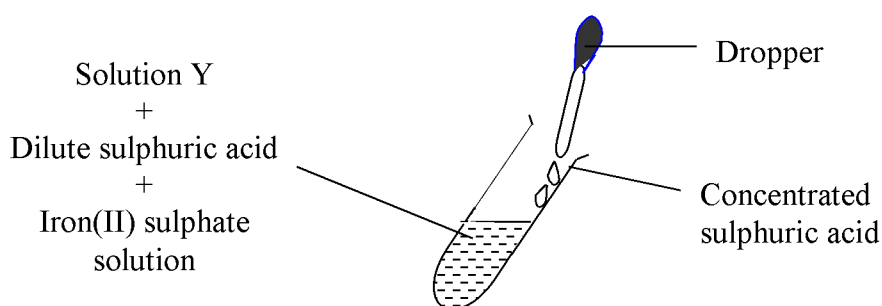
Which of the following substances could be K?

A Magnesium nitrate

B Potassium chloride

C Sodium sulphate

D Sodium oxide



[SBPdiag07-30] Below is the diagram of set up of apparatus to verify the presence of an anion. What anion can be identified from this confirmatory test?

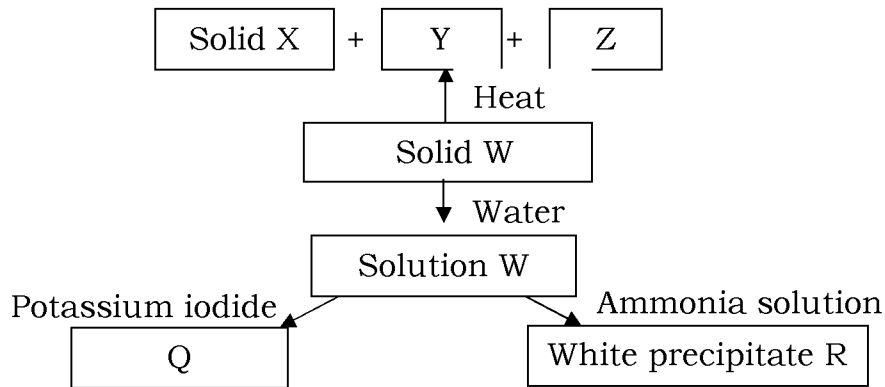
A Nitrate ion

B Sulphate ion

C Chloride ion

D Carbonate ion

1. Figure below shows a series of changes involving solid W. **[SBPmidyearF507-05]**



Gas Y is colourless. Gas Z is brown in colour. Solid X is brown in colour when hot and yellow in colour when cold.

(a) Identify: [3M]

(i) gas Y :.....

(ii) gas Z :.....

(iii) solid X :.....

(b) Describe a chemical test to identify the gas Y. [2M]

.....

(c) (i) Name the cation in solution W. [1M]

.....

(ii) Write the ionic equation for the reaction between solution W and ammonia solution. [1M]

.....

(iii) Name the white precipitate R. [1M]

.....

(d) In another experiment, potassium iodide solution is added to solution W.

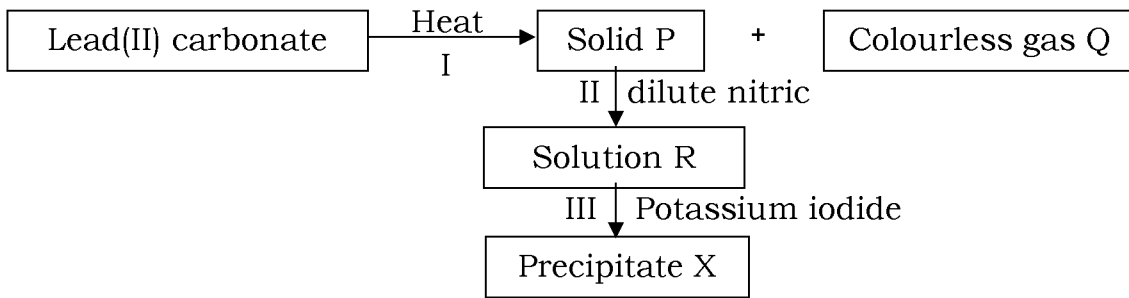
(i) State what can be observed. [1M]

.....

(ii) Name the reaction that takes place in d (i). [1M]

.....

2. Diagram 3 shows a series of reactions of lead(II) carbonate. **[SBPtrial08-03]**



(a) (i) Name the solid P. [1M]

.....

(ii) Draw a labelled diagram of the setup of apparatus can be used to produce solid P and to identify gas Q in step I. [2M]

(iii) Write the chemical equation for the decomposition of lead(II) carbonate when heated.

.....

(iv) 13.35 g lead(II) carbonate is heated to decompose completely, calculate the volume of gas Q produced at room condition. [2M]

[Relative atomic mass: Pb=207, C=12, O=16 and 1 mol of gas occupies 24 dm³ at room condition]

(b) (i) Name the precipitate X. [1M]

.....

(ii) State the colour of precipitate X. [1M]

.....

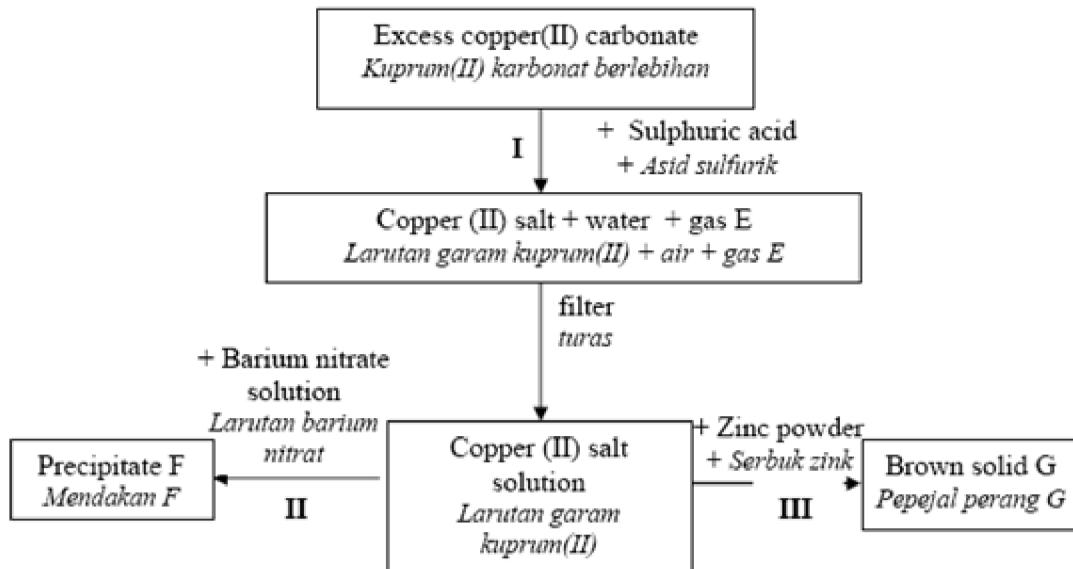
(iii) Write the ionic equation for the formation of precipitate X. [1M]

.....

(iv) How to obtain precipitate X from the mixture. [1M]

.....

3. The following flow chart shows the formation of a copper (II) salt solution and a series of its reactions. [MRSM09-05]



(a) (i) State one observation in Reaction I. [1M]

.....

(ii) Name the copper(II) salt and gas E that are produced in Reaction I. [2M]

Copper(II) salt : Gas E :

(b) (i) Name the process occurred in Reaction II to produce precipitate F. [1M]

.....

(ii) Write an ionic equation for the formation of precipitate F. [1M]

.....

(iii) If 0.02 mol of precipitate F is formed, calculate the volume of 0.5 mol dm⁻³ of barium nitrate solution used. [2M]

(c) Brown solid G is formed when zinc powder is added to copper(II) salt solution in Reaction III. Explain. [2M]

.....

.....

(d) State the observation when aqueous ammonia is added till excess to the copper(II) salt solution. [2M]

.....

.....