



EXERCISE 3.5

MODULE 3 TOPIC 3
Units 3 & 4, p. 137–145
Gr 10 Physical Sciences 3-in-1

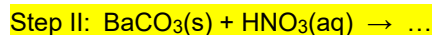
QUESTION 1

- 1.1 Provide ONE term for the insoluble substance that forms when certain solutions of ionic salts are added together.
- 1.2 Describe the physical appearance of the CuCO_3 crystals.
- 1.3 Write equations to represent the dissociation reactions of $\text{Cu}(\text{NO}_3)_2(\text{s})$ and $\text{Na}_2\text{CO}_3(\text{s})$.
- 1.4 Write an ionic equation to represent the reaction that takes place when the two solutions in QUESTION 1.3 are mixed.
- 1.5 For the reaction in QUESTION 1.4:
- 1.5.1 Identify the spectator ions in the filtrate. 1.5.2 Write the net ionic equation.

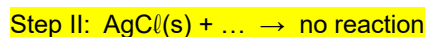
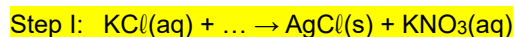
QUESTION 2

Complete the following reactions by filling in the missing reactants/products, where applicable:

2.1 Test for carbonate ions:



2.2 Test for chloride ions:



2.3 What is the colour of the insoluble solid formed in Step I of QUESTION 2.2?

QUESTION 3

Three test tubes marked A1 – A3 and three test tubes marked B1 – B3 respectively are filled with the solutions indicated below. Three sets of each solution are prepared.

		Solutions in test tube B		
		B1	B2	B3
Solutions in test tube A		AgNO_3	Na_2CO_3	$\text{Ba}(\text{NO}_3)_2$
A1	LiCl		xxxxx	
A2	MgSO_4			
A3	AlBr_3			

The following experiments are conducted with the contents of the test tubes:

- experiment 1: test tube A1 is added to test tube B1
- experiment 2: test tube A2 is added to test tube B1
- experiment 3: test tube A3 is added to test tube B1

3.1 Make use of the table 'solubility of salts' on p. xx and provide an:

- o observation to confirm that a reaction has taken place
- o ionic equation for the reaction that takes place in

3.1.1 experiment 1 3.1.2 experiment 2 3.1.3 experiment 3

3.2 What are these types of reactions called?

3.3 What is the driving force for these reactions?

3.4 Chlorides and sulphates are found in water. These ions may be identified by the insoluble substances they form in chemical reactions.

3.4.1 Provide ONE combination of test tubes (**A1 to A3** and **B1 to B3**) from the table above that may be used as a test for sulphates.

3.4.2 Write the chemical equation for the reaction between the solutions in the test tubes identified in QUESTION 3.4.1.

3.4.3 What is the colour of the insoluble solid formed during the reaction in QUESTION 3.4.1?

3.4.4 Describe a further test that can be performed to confirm that the insoluble salt formed in QUESTION 3.4.3 is a sulphate and not a carbonate.

3.5 Provide ONE other combination of the solutions in the test tubes (except A1 and B2) that will:

3.5.1 form an insoluble salt. Give the chemical name of this salt.

3.5.2 not form an insoluble salt, i.e. the ions remain in solution and no reaction takes place.

QUESTION 4

The six experiments (**A** to **F**) below are performed in a laboratory to conduct an investigation into the different types of reactions and the driving force behind each.

Experiment **A**: A clean test tube is filled halfway with dilute HCl . A spatula of $\text{Na}_2\text{CO}_3(\text{s})$ is added to the test tube.

Experiment **B**: A pea-sized piece of sodium is dropped into a bowl of water.

Experiment **C**: Solutions of KI and AgNO_3 are prepared by adding a spatula of each salt to a beaker with water. More or less equal volumes of the $\text{KI}(\text{aq})$ and $\text{AgNO}_3(\text{aq})$ are mixed together in a clean test tube.

Experiment **D**: $\text{MnO}_2(\text{s})$ is added to a clean test tube. The mouth of the test tube is covered with a balloon. A Bunsen burner is used to carefully heat the content of the test tube.

Experiment **E**: Approximately 5 cm^3 of $\text{CuSO}_4(\text{aq})$ is added to a test tube. A small amount of $\text{Zn}(\text{s})$ powder is added to the test tube.

Experiment **F**: Solutions of HCl and NaOH with equal concentrations are prepared. 5 cm^3 of $\text{HCl}(\text{aq})$ is added to a clean test tube. The solution is tested with blue litmus paper. Exactly 5 cm^3 of $\text{NaOH}(\text{aq})$ is added to the content of the test tube. The nature of the solution is tested again with the same litmus paper. More $\text{NaOH}(\text{aq})$ added and the solution is tested again with the litmus paper.

4.1 For each experiment (**A – F**):

- o write the expected observation
- o write the molecular equation for the reaction that takes place
- o classify the reaction as a *precipitation reaction*, *gas formation reaction*, *acid-base reaction* or *redox reaction*.

4.2 What are the driving forces of reactions **E** and **F** respectively.

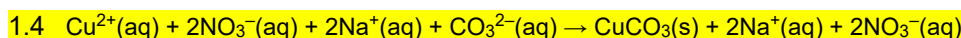
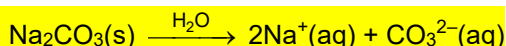
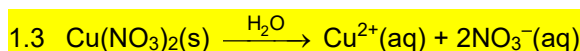
4.3 Give the broad term for all these types of reactions excluding the redox reactions.

EXERCISE ANSWERS

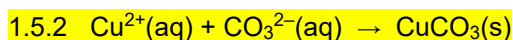
QUESTION 1

1.1 precipitate

1.2 blue crystals



1.5.1 $\text{Na}^+(\text{aq})$ and $\text{NO}_3^-(\text{aq})$



QUESTION 2

2.1 Step I: $\text{Ba(NO}_3)_2$

Step II: $\text{Ba(NO}_3)_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

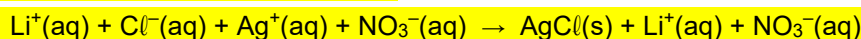
2.2 Step I: AgNO_3

Step II: HNO_3

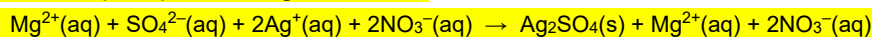
2.3 white

QUESTION 3

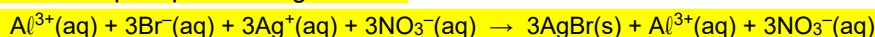
3.1.1 a white precipitate of AgCl forms



3.1.2 a white precipitate of Ag_2SO_4 forms



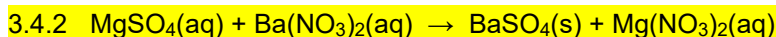
3.1.3 a cream precipitate of AgBr forms



3.2 ion exchange or precipitation reactions

3.3 the formation of a precipitate

3.4.1 A2 and B3, i.e. MgSO_4 and $\text{Ba(NO}_3)_2$



REMEMBER

Look out for Ba^{2+} ions to combine with the sulphate. With the ion exchange, BaSO_4 will form, which is an insoluble salt.

3.4.3 white

3.4.4 Add HNO_3 to the precipitate. If no reaction occurs, it is a sulphate.

3.5.1 ○ A2 and B2, i.e. MgSO_4 and Na_2CO_3

○ Magnesium carbonate



REMEMBER

With the ion exchange MgCO_3 will form, and except for Na^+ , K^+ and NH_4^+ , all other carbonates are insoluble.

3.5.2 A1 and B3 **OR** A3 and B3



REMEMBER

Look out for NO_3^- , Cl^- , Br^- and I^- ions. All nitrate salts are soluble and halide salts are mostly soluble, except when they bond to Ag^+ or Pb^{2+} ions, which are not present here.

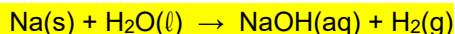
QUESTION 4

4.1 A – Gas bubbles (CO_2) can be observed in the test tube.



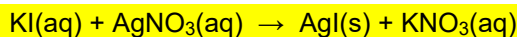
gas formation reaction **OR** acid-base reaction

B – The sodium melts and a sizzling sound is heard. Gas bubbles (H_2) can be observed in the bowl of water.



gas formation reaction **OR** redox reaction

C – A yellow precipitate of silver iodide can be observed.



precipitation reaction

D – The balloon blows up slightly due to the formation of O_2 gas.



gas formation reaction

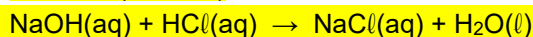
E – The blue CuSO_4 solution becomes clear and a reddish-brown solid (Cu) forms at the bottom of the test tube.



redox reaction

F – The colour of the litmus paper turns red in the HCl (acidic);

green in the salt solution (neutral) and blue when an excess of NaOH is added (alkaline)



Acid-base reaction

4.2 E – transfer of electrons

F – transfer of protons (H^+)

4.3 ion-exchange reactions