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SUPERVISOR'S USE ONLY

Level 1 Chemistry, 2015

90934 Demonstrate understanding of aspects of chemical reactions

9.30 a.m. Tuesday 24 November 2015
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of chemical reactions.	Demonstrate in-depth understanding of aspects of chemical reactions.	Demonstrate comprehensive understanding of aspects of chemical reactions.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table and other reference material are provided in the Resource Booklet L1–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 17

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QUESTION ONE

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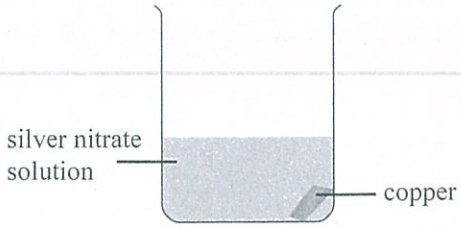
(a) A piece of copper was added to a solution of silver nitrate in a beaker, and left for one day.



(i) Identify the type of reaction occurring in the beaker.

Redox Displacement Reaction

(ii) Describe the observations occurring, and link them to the reactants and products involved.

The copper is more reactive than silver and so it will displace the silver ions in the solution. The solution in the beaker will start to ~~change~~ turn blue and this is because the copper enters the solution. Black/grey deposit will form on the piece of metal as the silver ions ~~form~~ form silver metal. The piece of metal will also start dissolving as the copper leaves.

(iii) Write a balanced ionic equation for the reaction occurring in the beaker.

$Cu_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$

Equation needs to be balanced so as to provide sufficient evidence towards Excellence.

The explanation of copper entering & leaving a solution is not specific enough to show in depth understanding

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(b) A strip of silver-grey metal is known to be either **silver** or **magnesium**.

Explain how the identity of the metal could be determined by adding **copper sulfate** solution to the strip of metal, and leaving it for one day.

In your answer, you should:

- give any observations you would expect to see if the metal is:
  - silver, and
  - magnesium,

  and link them to the relevant species present
- explain why a chemical reaction may or may not occur, depending on whether the metal is silver or magnesium.

* Copper is less reactive than magnesium and more reactive than silver. This means that a chemical reaction will only occur when magnesium is put in copper sulfate solution.

Magnesium:
When magnesium is put in copper sulfate, the magnesium will displace the copper in the solution. The blue colour of the solution will start to fade as the copper ions (which give the colour) ~~fade~~ leave the solution. Orange brown deposit will form on the piece of metal. This is ~~the~~ because the magnesium has displaced the copper and the copper metal is starting to form. The piece of metal may start to dissolve because the magnesium displaces and enters the copper sulfate solution.

Silver:
There will be no displacement reaction between silver and copper sulfate solution because silver is less reactive than copper. This means the metal will stay the same and solution will stay blue.
Therefore, if there is a displacement reaction, the metal can be identified as magnesium.

* The evidence needs to link to the activity series so as to show how the candidate knows that copper is more reactive than Mg & less reactive than Ag.

M5

QUESTION TWO

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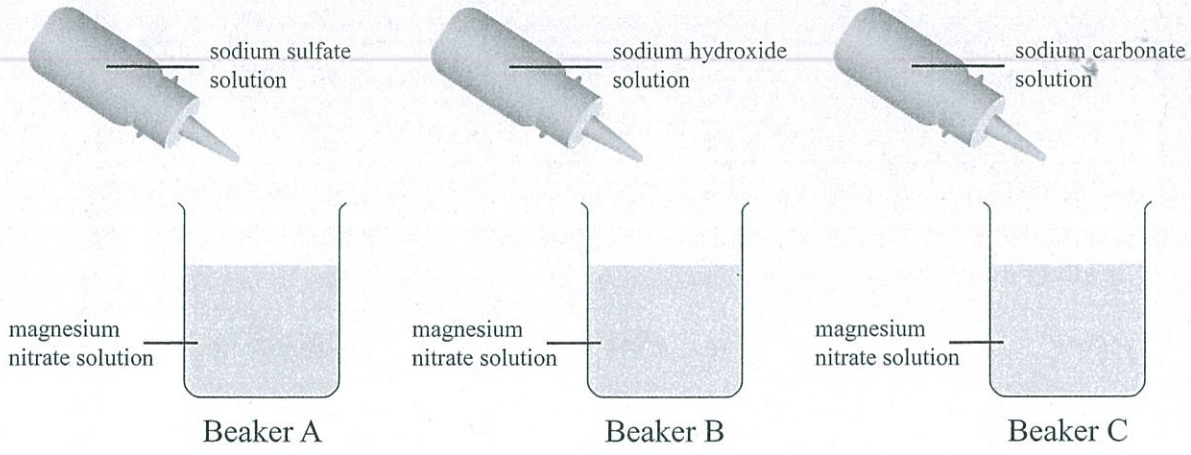
(a) Three different solutions were added to separate beakers containing a solution of magnesium nitrate. Only two of the mixtures produced precipitates.



Complete the table below by identifying:

- whether a precipitate forms
- the name of any precipitate that may have formed in the beakers.

You may use the solubility rules provided in the resource booklet.

	Precipitate forms? Yes / No	**Name of precipitate**
Beaker A	no	–
Beaker B	yes	magnesium hydroxide
Beaker C	yes	magnesium carbonate

(b) (i) Iron(II) sulfate solution and sodium hydroxide solution react to form a precipitate.

Complete the following ionic equation to show the formation of the precipitate.

$Fe^{2+}_{(aq)} + 2\,OH^-_{(aq)} \rightarrow Fe(OH)_{2\,(s)}$

(ii) Elaborate on the reaction occurring in (b)(i).

In your answer, you should:

- explain why the reaction is classified as a precipitation reaction by referring to the ions in both solutions and the precipitate formed
- describe any observations that would be seen, and link them to the reactants and products involved.

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A precipitation reaction occurs when two solutions are added together and a precipitate (solid) forms. The $Iron^{(II)}$ ions attract and combine with the hydroxide ions to form iron hydroxide. Because iron hydroxide is insoluble, it is a precipitate. The solution in the beaker may turn into a green colour because iron hydroxide is green and until they settle at the bottom, the solution may look like it changed colour. The sodium and sulfate ions in this reaction are spectator ions and will remain separated in the solution. When the iron hydroxide precipitate settles, there will be green in clear solution.

"Clear" is not considered evidence towards a colorless solution.
To get excellence in this part of the question, there needs to be links between the colors of the reactants as well as product.

(c) A sample of water is required to be tested for the presence of calcium ions and silver ions. It is known that the sample of water does not contain any other positive ions/cations.

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Explain how the sample of water could be tested to show whether or not it contains calcium ions, or silver ions, or both.

In your answer, you should:

- write a method that could be carried out in a school laboratory
- name any chemicals you would use
- identify any precipitates formed and link these to any observations that would be made
- explain how the results are used to determine which ions are present or absent.

You should use the solubility rules provided in the resource booklet.

A method to test the water could be to add sulfuric acid. When the sulfuric acid reacts with the water, a precipitate may form. All sulfates are soluble except $BaSO_4$, $PbSO_4$ and $CaSO_4$. Therefore if there are silver ions, there will be no precipitate. ~~and~~ If there are calcium ions, a white precipitate will form in the water. The white precipitate is Calcium sulfate. If the water remains clear there are no ~~silver nor~~ calcium ions and so silver ions are present. The water can be tested for silver ions by adding chlorine. If there is a white precipitate formed there is Silver Chloride. If there is no reaction, there are calcium ions.

Chlorine is not a valid option to test for ions. The candidate needs to refer to a chloride solution.

M 6

QUESTION THREE

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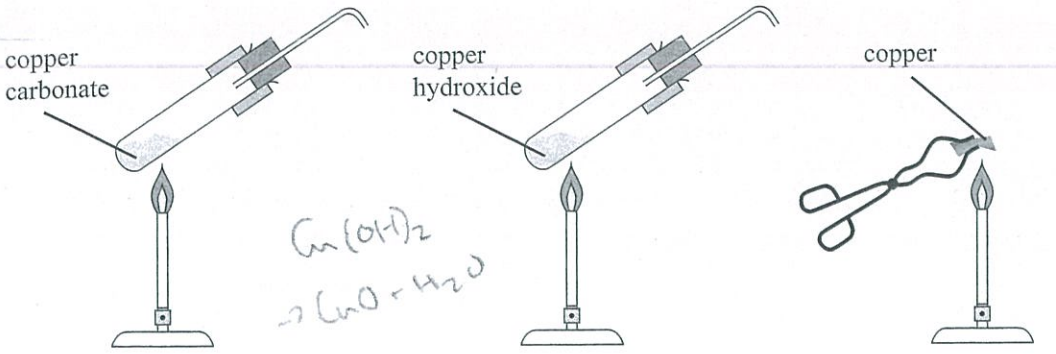
A student made samples of copper oxide using three different methods in a school laboratory.



Reaction 1 **Reaction 2** **Reaction 3**

(a) (i) Identify the type of reaction occurring in each experiment.

Reaction 1: thermal decomposition

Reaction 2: thermal decomposition

Reaction 3: combination reaction

(ii) Describe any observations that would be made during each experiment, and link them to the reactants and products involved.

Reaction 1: The blue colour of copper carbonate will turn black. There may be jumping/bubbling of the powder. It turns black because copper oxide is formed when the copper carbonate breaks down into copper oxide + carbon dioxide. The jumping of the powder shows carbon dioxide.

Reaction 2:

The blue copper hydroxide will turn black → turns into copper oxide. Condensation will form in the test tube. H_2O (water) is a product of the reaction and will be released in gas form but will turn into water droplets.

Reaction 3:

The copper (silver, grey metal) strip will burn with a bright light. As it burns with oxygen, black ash will be produced which is copper oxide ✓

Observations are only correct for one reaction.

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(b) Explain how the student could identify ONE of the products for each of reactions 1 and 2.

a link is made to identify product

Reaction 1: Carbon dioxide can be identified with the limewater test. The limewater will turn milky/cloudy when CO_2 is bubbled through.

Reaction 2: Water can be identified with cobalt chloride paper. The cobalt chloride will turn from blue to pink when in contact with H_2O.

(c) Compare and contrast the three reactions in part (a) on the previous page.

In your answer, you should:

- write word and balanced symbol equations for all three reactions in the boxes provided below
- explain what is occurring during each of the different reactions
- where relevant, explain the reaction(s) in terms of electron transfer.

Reaction 1

Word equation:

Copper Carbonate → Copper Oxide + carbon dioxide

2 correct equations

Balanced symbol equation:

$Cu CO_{3\,(s)} \rightarrow CuO_{(s)} + CO_{2\,(g)}$

Reaction 2

Word equation:

Copper Hydroxide → Copper Oxide + Water

Balanced symbol equation:

$Cu(OH)_{2\,(s)} \rightarrow CuO_{(s)} + H_2O_{(g)}$

Reaction 3

Word equation:

Copper + Oxygen → Copper Oxide

Balanced symbol equation:

$2Cu + O_2 \rightarrow 2CuO$

1 When copper carbonate is heated, it thermally decomposes into copper oxide and carbon dioxide. The heat makes it break down from one substance into two.

2. Like in reaction 1, reaction 2 is also thermal decomposition. The heat applied to copper hydroxide makes it decompose into copper oxide and water.

3. Reaction 3 is a combination reaction. The heat helps the copper to react with oxygen and form copper oxide. Because the two ~~rea~~ products react together to form a compound, there is a chemical bond between them (unlike mixtures where there is no reaction). The positive copper ions attract the negative oxide ions which produces a strong bond. ~~When becoming~~ When they are reacted together, the Cu^{2+} ions balance out the O^{2-} ions and the product is neutral. When Copper becomes an ion it loses two electrons and oxygen atom gains two electrons to become an oxide ion.

compared 2 reaction

a link of Cu losing electron + oxygen gaining electron is made.

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There are sufficient links to merit a 6 but understanding is not comprehensive enough to get the E7.

M6