Assessment schedule – 2018

Chemistry: Demonstrate understanding of aspects of chemical reactions (90934)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	$Mg^{2+} + 2OH^- \rightarrow Mg(OH)_2$	• Correct unbalanced equation.	• Correct equation.	
(ii)	When **colourless** sodium hydroxide solution is added to **colourless** magnesium chloride solution, a **white precipitate** of magnesium hydroxide forms and a **colourless** solution of sodium chloride.	• White precipitate formed.	• Links white precipitate to $Mg(OH)_2$.	• Comprehensively links all observations to the reactants and products.

(b)

Unknown solution		Sodium iodide	Sodium sulfate	Sodium carbonate
Lead nitrate	Expected observations	Yellow precipitate	White precipitate	White precipitate
	Formula of precipitate	PbI_2	$PbSO_4$	$PbCO_3$
Magnesium nitrate	Expected observations	No change	No change	White precipitate
	Formula of precipitate			$MgCO_3$
Barium nitrate	Expected observations	No change	White precipitate	White precipitate
	Formula of precipitate		$BaSO_4$	$BaCO_3$

Step 1
Add sodium sulfate to each of the unknown solutions A, B, and C. Two solutions will form a white precipitate. These solutions are lead nitrate and barium nitrate. Magnesium nitrate will not form a precipitate, and therefore can be identified.

Step 2
Add sodium iodide to the two remaining unknown solutions. Only the lead nitrate solution will form a yellow precipitate. The barium nitrate will not form a precipitate.

(The sodium carbonate solution is not needed to identify any of the solutions since they all form a white precipitate.)

Equations:
$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$

$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

<u>Alternate method:</u>
Step 1
Add sodium iodide to each of the 3 unknowns A, B and C. One solution will form a yellow ppt. This solution is the lead nitrate. The other two solutions will not form a ppt. (they are barium nitrate and magnesium nitrate).
Step 2
Add sodium sulfate to the two remaining solutions. Only the barium nitrate will form a ppt, the magnesium nitrate is identified as it doesn't form a ppt.

Equations:
$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$
Note: Accept other feasible methods using all three solutions (including sodium carbonate) for Achievement and Merit.

- One correct observation for one of the reactions.
- One correct precipitate for each unknown.
- Give a feasible method.

- Explains method with relevant observations and precipitate formulae for determining the identity of two unknown solutions.

- A comprehensive method (clear procedure), with observations, precipitate formulae and ONE balanced ionic equations.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	1e in 1(b)	2e

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	(i) circled Magnesium is higher on the activity series of metals than zinc. This means magnesium is more reactive than zinc. So, magnesium atoms will lose electrons to form magnesium ions more easily than zinc atoms loses electrons to form zinc ions. This is what is already present in the test tube, as magnesium nitrate contains magnesium ions and zinc metal contains zinc atoms. Therefore, no reaction occurs.	• (i) circled and magnesium is more reactive/higher on activity series than zinc or zinc is less reactive than magnesium.	• (i) circled and magnesium is more reactive but is already magnesium ions / zinc is less reactive and is already zinc atoms / magnesium atoms will lose electrons more easily.	• (i) circled with full explanation. **OR**
(b)	(iii) circled Initially the solution is blue due to the Cu^{2+} ions in the solution. As zinc is more reactive than copper, zinc atoms donate electrons to go into the solution as zinc ions which are colourless. Copper ions accept the electrons to form copper metal. As the concentration of copper ions in the solution decreases, the blue colour of the solution fades and eventually disappears as they are replaced by colourless Zinc ions.	• (iii) circled and blue colour of solution fades / goes colourless.	• (iii) circled and blue solution due to Cu^{2+} ions, colour gets lighter / colourless. • Explains colour fading due to Cu^{2+} gaining electrons OR that Zn is more reactive than Cu, so Cu ions are removed	(iii) circled and full explanation including Zn and Cu reactivity, electron transfer and colours of both Cu and Zn ions.
(c)	(ii) circled Lead is higher in the activity series and is therefore more reactive than silver. Therefore, lead atoms lose electrons and go into the solution as lead ions. Silver ions gain electrons and form silver atoms, that is, silver metal. So the new solid that is formed is silver. This is a displacement reaction. A more reactive metal displaces ions of a less reactive metal. $Pb(s) + 2Ag^{+}(aq) \rightarrow Pb^{2+}(aq) + 2Ag(s)$	• (ii) circled and lead is more reactive than silver. • recognises displacement reaction in (b) or (c).	• (ii) circled and lead more reactive / silver less reactive and some reference to electron loss / gain • Displacement reaction explained and unbalanced equation correct.	• (ii) circled and full explanation, including balanced equation and electron loss / gain for reactant to product, e.g. Pb loses electrons to form Pb^{2+}.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4 a	2m	3m	1e	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	Decomposition reactions.	• Correct.		• Explanation for Reaction Two. AND Observations linked to species for Reaction One. AND Balanced symbol equation correct.
(ii)	A single reactant, barium hydroxide, decomposes / breaks down when heated, forming two simpler products, barium oxide and water.	• Decomposition reaction described.	• Decomposition reaction explained, linking to reactant and products.	
(iii)	The **colourless** solution/liquid of hydrogen peroxide, when **black** solid MnO_2 is added, would produce **a colourless** liquid of water, bubbles of **colourless** oxygen gas would form, and it would get **warm**. The **MnO_2 remains**.	• One observation correct.	• Observations linked to reactant and products	
(iv)	Sodium hydrogen carbonate → sodium carbonate + carbon dioxide + water $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$	• One product correct.	• Word equation correct. OR Unbalanced symbol equation correct.	
(b)	**Reaction One:** This is a combination reaction. Two simpler reactants/elements, lead and iodine are combined to form a more complex product/compound, lead iodide. $Pb + I_2 \rightarrow PbI_2$ Lead loses electrons to form lead ions and iodine gains electrons to form iodide ions.	• Reaction One is combination with some description.	• Reaction type explained for Reaction One OR Reaction Two. • One unbalanced equation correct from (b).	• Comprehensive answer including justifications of both reaction types, reference to electron transfer for combination and insoluble solid for precipitation and balanced equations for ONE reaction in (b).
	Reaction Two: This is a precipitation reaction (or exchange reaction) because when the two solutions (lead nitrate and sodium iodide) are added together, an insoluble solid called a precipitate (lead iodide) forms OR because when the two solutions are added together, ions from each substance are swapped or exchanged, and an insoluble substance, lead iodide forms. $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2 + 2NaNO_3$ OR $Pb^{2+} + 2I^- \rightarrow PbI_2$ (There is no transfer of electrons in this reaction.)	• Reaction Two is precipitation with some description.		

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	3a	4a	5a	3m	4m	1e	2e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19 – 24