Assessment schedule – 2021

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE	*Note: the original examination paper contained an error in this question, the evidence below is designed to take this into account*			• Balanced ionic equation for a precipiate. AND
(a)(i)	$Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$	• Word equation.	• Balanced ionic equation for the ions provided in the question.	
(ii)	When colourless magnesium sulfate solution is added to colourless barium chloride solution a white precipitate of barium sulfate will be formed in a colourless solution of magnesium chloride *Evidence accepted for paper sat:* • *When colourless magnesium sulfate solution is added to colourless barium hydroxide solution a white precipitate of barium sulfate (magnesium hydroxide) will be formed in a colourless solution.* • *discussion explaining lack of precipitation due to $Ba(OH)_2$ insolubility.*	• States an observation. E.g. $MgSO_4$ is colourless	• Links three observations to species.	Links observations to species present in reactant and product solutions. AND
(iii)	This reaction is a precipitation reaction because when the two solutions (magnesium sulfate and barium chloride) are mixed, there is a combination of ions in the product solution which will combine to form an insoluble compound. The Ba^{2+} ions can combine with the SO_4^{2-} ions to form insoluble $BaSO_4$. *Evidence accepted for paper sat:* • *The Mg^{2+} ions can combine with the OH^- ions in solution to form insoluble $Mg(OH)_2$.* • *Explanation of why there is no reaction.*	• Describes a precipitation reaction (*or lack of*).	• Explains precipitation reaction (*or lack of*).	Explains precipitation reaction with reference to formation of solid precipitate. OR *Explains that a precipitation reaction should not occur*.

(b)	Add sodium hydroxide solution to each of the unknown solutions. One solution will form a white precipitate. This solution is aluminium nitrate. The white precipitate is aluminium hydroxide. One solution will form a green precipitate. This solution is iron(II) nitrate. The green precipitate is iron(II) hydroxide. One solution will not form a precipitate. This solution is potassium nitrate. $Fe^{2+} + 2\ OH^- \rightarrow Fe(OH)_2$ $Al^{3+} + 3\ OH^- \rightarrow Al(OH)_3$	• One correct observation for one of the reactions. • One correct precipitate for one unknown. • Give a feasible method.	• Explains method with relevant observations and precipitate formulae for determining the identity of all unknown solutions. OR Both unbalanced equations.	• A comprehensive method (clear procedure), with observations, precipitate formulae and both balanced ionic equations.
(c)	**Step 1** Add sodium hydroxide or sodium carbonate solution to the sample of drinking water. No precipitate should form, indicating that there are no magnesium or calcium ions. If magnesium or calcium ions were present, a white precipitate would form. **Step 2** To a new sample of the drinking water, add silver nitrate solution. A white precipitate of silver chloride should form, indicating the presence of chloride ions.	• One reagent correctly explained.	• Both reagents correctly explained.	

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

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	Reaction 1 displacement Reaction 2 decomposition Reaction 3 combination	• TWO correct.		
(ii)	The solution will remain colourless as both Al^{3+} and Mg^{2+} are colourless in solution. A grey solid, Al will form on the Mg solid. $3Mg + 2Al(NO_3)_3 \rightarrow 2Al + 3Mg(NO_3)_2$	• Observations correct.	• Observations correctly linked to the species. OR Unbalanced equation.	• For Reactions 1 and 3: Observations linked to species.
(iii)	hydrogen peroxide → water + oxygen This is a decomposition reaction as one reactant (hydrogen peroxide) forms two products (water and oxygen)	• Correct word equation. • Correct description.	• Explained in terms of reactants and products.	AND Correct balanced equations.
(iv)	Yellow sulfur solid burns in the colourless oxygen gas with a bright blue flame and produces colourless sulfur dioxide. $S + O_2 \rightarrow SO_2$	• Two observations correct.	• Observations correctly linked to the species. OR Balanced equation.	
(b)	Heat a small amount of each white solid in separate boiling tubes, causing them to undergo thermal decomposition to produce gaseous products. The gases produced on heating can then be passed through delivery tubes into test-tubes of limewater. If the limewater turns cloudy this indicates carbon dioxide has been produced. If the limewater remains clear, then no carbon dioxide was produced. Heating each white solid in boiling tubes and holding a piece of blue cobalt chloride paper in any vapour / steam / gas coming from the boiling tube may cause the paper to turn pink. This indicates water vapour was produced in the decomposition reaction. Calcium carbonate will decompose to produce carbon dioxide, and not water vapour. $CaCO_3 \rightarrow CaO + CO_2$ Calcium hydroxide will decompose to produce water vapour, but no carbon dioxide. $Ca(OH)_2 \rightarrow CaO + H_2O$ Sodium hydrogen carbonate will decompose to produce water vapour and carbon dioxide gas. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$	• ONE test for a product is described. OR • Indicates both need to be heated. OR • ONE reaction correctly described.	• TWO powders correctly identified. Correct thermal decompositions explained with equations, but incorrect tests. • Method written that uses both tests to identify all three solids, but incorrect equations.	• Comprehensive method for the identification of all three white solids, with correctly balanced equations.

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

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	In test-tube B there will be evidence of a new solid forming on the surface of the magnesium. The new solid is zinc. No changes will be observed in test-tube A. (The solution will remain colourless.)	• New solid in B. OR No change in A.		
(ii)	In test-tube B reaction will occur where a more reactive metal (higher on the activity series) will displace a less reactive metal (lower on the activity series) ion from the solution. No changes will be observed in test-tube A. (The more reactive metals will transfer electrons to the metal ions during the displacement reactions.) In the test-tube with magnesium metal and zinc nitrate solution, a displacement reaction occurs because magnesium metal is more reactive (higher on the activity series) than zinc metal, so it displaces the zinc ions in the solution. In the test-tube with zinc metal and magnesium nitrate, no reaction occurs because the magnesium ions are not displaced by the zinc metal since magnesium is more reactive than zinc.	• Describes displacement reaction. • Describes electron transfer correctly. OR Describes reactivity based on activity series.	• Explains displacement reaction in test tube B with reference to activity series. OR Explains why no reaction occurs in test tube A. • Explains why no reaction occurs in test tube A.	• Elaborates on displacement reaction with reference to activity series and electron transfer. AND explains why no reaction occurs in test tube A.
(b)	Both these reactions are combination reactions – two elements combine to form one single compound. Pink / brown copper metal reacts with colourless oxygen gas to form black copper (II) oxide. The metal will glow bright orange as it reacts. Grey aluminium metal reacts with colourless oxygen gas to form grey / white aluminium oxide. Electrons are transferred from the metal atoms to the oxygen molecules, forming metal cations and oxide anions. $2Cu + O_2 \rightarrow 2CuO$ $4Al + 3O_2 \rightarrow 2Al_2O_3$	• Combination reaction described. • Observations for one reaction described. • Correct reactants / products for equations.	• Combination reactions explained. • Unbalanced equations. • Observations for both reactions linked to reactant and product species.	• Full elaboration of reaction type, electron transfer, observations, and correct balanced equations for both reactions.

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 –13	14 – 18	19 – 24