Assessment schedule – 2023

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	Potassium carbonate / sodium carbonate	• Correct solution named.		• Correct reaction types.
(ii)	Precipitation reaction. Potassium carbonate / sodium carbonate are soluble solutions so can be added to the hard water. Both magnesium and calcium carbonate are insoluble, so when the Mg^{2+} and Ca^{2+} ions come into contact with the CO_3^{2-} ions, a solid white precipitate will form (of $MgCO_3$ / $CaCO_3$).	• Correct reaction type.	• Reaction type explained with reference to solubility.	AND Reaction type justified with reference to solubility and all observations given. AND
(iii)	$Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$ $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$	• Reactants / products correct for ONE equation.	• ONE unbalanced equation.	ONE correct balanced equation (states not necessary).
(b)	This is a displacement (oxidation-reduction) reaction; the Fe displaces the lead ions from the solution as iron is higher on the reactivity series / more reactive than lead. A grey coating may be visible on the surface of the iron as the solid lead forms. The solution will slowly change from colourless to pale green as Fe^{2+} ions form. This method may allow removal of some lead ions, but will put iron ions into solution so probably not a good method. $Pb^{2+}(aq) + Fe(s) \rightarrow Pb(s) + Fe^{2+}(aq)$ Both calcium and magnesium ions remain in solution, as they are higher up the activity series than iron, so it cannot displace them from solution.	• Correct reaction type. OR Describes TWO observations. • Reactants / products correct.	• Links the observations to TWO of the reactants and products. • Explains why Pb^{2+} will react OR why Ca^{2+} / Mg^{2+} will not react, with reference to the activity series.	• Comprehensively links ALL observations to the reactants and products, and comments on suitability of lead ion removal method. AND Correct balanced equation. • Explains why Pb^{2+} will react, while Ca^{2+} and Mg^{2+} will not, with clear, specific reference to the activity series.

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

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	Combination reaction.	• Correct reaction type.		• Correct reaction type. AND Elaborates on the iron sulfide formation linking ALL observations to the reactants and products.
(ii)	Yellow sulfur powder and grey iron wool react with an orange glow to form black iron sulfide. *(Black solid is no longer attracted to a magnet – acceptable observation.)*	• Describes an observation.	• Links formation of iron sulfide to TWO observations.	
(iii)	$Fe(s) + S(s) \rightarrow FeS(s)$		• Gives the correct equation.	
(b)(i)	Thermal decomposition. When the compound is heated with a Bunsen burner, black copper oxide forms, and either carbon dioxide or water is released (as a gas). A limewater test is used to confirm the CO_2 gas. If the limewater turns cloudy, it indicates the compound is copper carbonate. Cobalt chloride paper is used to confirm if H_2O is released. It will turn from blue to pink which would indicate the compound is copper hydroxide.	• Correct reaction type. • Describes an observation. OR ONE of the tests.	• Explains how to test for H_2O, and gives the correct corresponding equation. • Explains how to test for CO_2, and gives the correct corresponding equation.	• Correct reaction type. AND Comprehensive explanation of how the thermal decomposition reaction occurs, including positive tests for CO_2 and H_2O, and what that indicates (in terms of what compound it must have been).
(ii)	$CuCO_3(s) \rightarrow CO_2(g) + CuO(s)$ $Cu(OH)_2(s) \rightarrow H_2O(g) + CuO(s)$	• Gives correct reactants / products for equations.		• THREE correct equations (part (a)(iii) and (b)(ii) of question).

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

<table>
<tr><th>Q</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr><td>THREE
(a)(i)</td><td><table><tr><th>Solution</th><th>Example</th></tr><tr><td>A</td><td>Na_2CO_3 or K_2CO_3</td></tr><tr><td>B</td><td>any iodide except AgI or PbI_2</td></tr><tr><td>C</td><td>lead nitrate</td></tr><tr><td>D</td><td>silver nitrate or silver sulfate</td></tr></table></td><td>• THREE correct solutions.</td><td>• FOUR correct solutions.</td><td>• FOUR correct solutions.

AND

Reaction type explained (all observations).</td></tr>
<tr><td>(ii)</td><td>These reactions are precipitation reactions (or exchange reactions) because when the two solutions are added together, an insoluble precipitate forms OR because when the two solutions are added together, ions from each substance are swapped or exchanged, and an insoluble substance (precipitate) forms, with a clear colourless solution.
Clear colourless solutions (options as per the table above for (a)) combine to form a yellow precipitate of silver carbonate and a white precipitate of lead carbonate.
$2Ag^+(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(s)$ (note: must be ionic equations)
$Pb^{2+}(aq) + CO_3^{2-}(aq) \rightarrow PbCO_3(s)$</td><td>• Precipitation reaction described.
• Products in ionic equations correct.</td><td>• Reaction type explained (with TWO observations).
• Unbalanced equations.</td></tr>
<tr><td>(b)</td><td>Reaction type: combination.
Grey sodium metal will react with the yellow green chlorine gas, which glows / burns with a bright orange / yellow colour flame during the process. A white solid sodium chloride is formed.
Electrons are transferred from the sodium atoms to the chlorine atoms.
$2Na + Cl_2 \rightarrow 2NaCl$</td><td>• Correct reaction type.
• A correct observation.
OR
Electron transfer described.</td><td>• Reaction type explained (with TWO observations) Unbalanced equation.
OR
Electron transfer explained.
OR
Unbalanced equation.</td><td>• Correct reaction type.
AND
Reaction type explained (all observations) including electron transfer.
• All balanced equations correct (from part (a)(iii) and (b)).</td></tr>
</table>

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24