Assessment Schedule – 2014

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

Evidence statement

ONE	Evidence	Achievement	Merit	Excellence
(a)	In Beaker 1, the blue solution will turn very pale or even colourless. There will be a pink-brown copper precipitate on the rod or on the bottom of the beaker. In Beaker 2, there will be no change.	• ONE observation of Zn in copper sulfate solution. • Identifies that Beaker 2 has no change.		
(b)(i)	This is a displacement reaction.	• Identifies displacement reaction.		
(ii)	Zinc is above copper in the activity series, it will have displaced Cu out of the copper sulfate solution by losing electrons that are gained by Cu^{2+}, which is why there is a pink-brown copper / Cu precipitate. Copper ions, Cu^{2+}, give the solution its blue colour, and since they are being removed from the solution, the colour of the solution fades to colourless (Zn^{2+} ions are colourless). There is no reaction in the second beaker because Zn is below Mg on the activity series so is unable to displace Mg out of the solution.	• Recognises Zn is above copper in the activity series.	• Links observations of Zn in copper sulfate solution to the displacement reaction. • Links the lack of reaction in Beaker 2 to the position of Mg in the activity series.	• Each reaction is explained with respect to observations with links to electron loss/gain, a justification of the choice of metal and the type of reaction occurring. • BOTH equations are correct and balanced.
(c)	$Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$		• Links a feasible solution to a displacement reaction with Pb^{2+} ions.	*Correctly balanced symbol equations can be accepted in place of ionic equations.* (*States are not required in balanced equations.*)
(d)	Any metal that is above Pb on the activity series is suitable because all metals above it on the activity series will displace lead out of solution. $Pb^{2+}(aq) + X(s) \rightarrow Pb(s) + X^{2+}(aq)$	• Identifies an appropriate metal.	• ONE equation has correct formulae but is not balanced.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	2a	3a	4a	3m	4m	2e with minor error or omission	2e

TWO	Evidence	Achievement	Merit	Excellence
(a)	Combination reactions which both require heat to occur.	• Identifies combination reaction AND states that heat is needed.		
(b)(i)	A grey strip of metal when heated in air, bursts into a bright white flame, producing a white powdery residue.	• Describes TWO observations for Reaction 1.	• Links observations to the reactants and products for Reaction 1.	
(ii)	The grey strip of metal is magnesium, which reacts with oxygen in the air. The powdery white substance formed is magnesium oxide.			
(iii)	Zinc sulfide, ZnS.	• Correctly names or gives the correct formula for zinc sulfide.		
(iv)	The grey powder is zinc powder, which reacts with the yellow powdered sulfur to form white zinc sulfide.		• Explains why atoms form ions.	
(c)	Each reactant, Mg, O_2, Zn, and S is less stable as atoms than they are as ions. To become stable, metal atoms empty their valence electron shells by losing electrons to non-metal atoms, which gain electrons to fill their valence electron shell. When Mg reacts with O_2, each Mg atom loses 2 electrons to form Mg^{2+}, which is more stable than Mg. Each O atom gains 2 electrons to form O^{2-}, which is more stable than the elemental O_2. Together they form MgO. Similary, Zn atoms lose 2 electrons each to S atoms, resulting in stable Zn^{2+} and S^{2-} ions forming ZnS.	• Recognises electron transfer OR formation of ionic compounds.	• Correctly explains one reaction in terms of electron transfer.	• Correctly explains both reactions in terms of electron transfer to then form compounds.
(d)	$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$ $Zn(s) + S(s) \rightarrow ZnS(s)$	• Write TWO correct formulae in ONE equation.	• One equation is correct.	• Both equations are correctly balanced. (*States are not required in balanced equations.*)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	2a	3a	4a	3m	4m	2e with minor error or omission	2e

THREE	Evidence	Achievement	Merit	Excellence
(a)(i)	The white $NaHCO_3$ would heat and form a white powder of Na_2CO_3. Water vapour would also form and may be seen as a colourless liquid on the insides of the tube.	• Describes an observation of $NaHCO_3$ decomposing.	• Links the observations to the correct species AND a test of the product to the correct species.	
(ii)	The CO_2 can be collected and bubbled into limewater, which would go milky to confirm that CO_2 is produced. OR blue cobalt paper could be used to test the colourless liquid. If it is water, the paper will turn pink.	• Describes a test for a product.		• Fully compares AND contrasts both decomposition reactions by linking all observations and species to the type of decomposition. (Appreciates that test tube 2, in Reaction 2, is still occurring slowly).
(b)	$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(\ell)$	• Describes an observation of H_2O_2 decomposing.		
(c)	Hydrogen peroxide is a colourless liquid, which decomposes slowly to form O_2 and H_2O, but with MnO_2 acting as a catalyst to speed up the reaction, there is vigorous bubbling to produce O_2 gas.	• Identifies ALL products (formulae or words) for ONE reaction, either (b) or (d).	• Links the role of MnO_2 to the catalytic decomposition.	
(d)	$2H_2O_2(aq) \rightarrow 2H_2O(\ell) + O_2(g)$		• Unbalanced symbol equation is given for either reaction.	
(e)	Both reactions show the initial substance decomposing to form more than one substance. Reaction 1 is an example of a **thermal** decomposition reaction. Reaction 2 is the **catalytic** decomposition of hydrogen peroxide where MnO_2 speeds up the rate at which H_2O_2 breaks down.	• Identifies thermal OR catalytic decomposition.	• Compares OR contrasts ONE aspect of the decomposition reactions.	• TWO balanced equations. (*States are not required in balanced equations.*)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	2a	3a	4a	3m	4m	2e with minor error or omission	2e

FOUR	Evidence	Achievement	Merit	Excellence
(a)	<table><tr><td>1</td><td>Lead iodide</td><td>PbI_2</td><td>yellow</td></tr><tr><td>2</td><td>No precipitate</td><td></td><td></td></tr><tr><td>3</td><td>Copper hydroxide</td><td>$Cu(OH)_2$</td><td>blue</td></tr></table>			
(b)	In Beaker 1, there are Pb^{2+}, NO_3^-, K^+ and I^- ions present. When mixed, a yellow precipitate of PbI_2 will form because iodides of lead are insoluble. It will not be KNO_3 because all nitrate compounds are soluble. K^+ and NO_3^- ions are the spectator ions. $Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$ OR $2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$ In Beaker 2, there are Na^+, Cl^-, NO_3^- and Fe^{3+} ions present. No combination of these produce an insoluble substance (precipitate) according to the solubility rules as sodium compounds are all soluble, as are nitrates. Chlorides are also soluble (except for silver and lead), so no chloride precipitate will form either. In Beaker 3, there are Cu^{2+}, SO_4^{2-}, Na^+ and OH^- ions present. All sodium compounds are soluble, but a blue precipitate of copper hydroxide forms as this is insoluble. The Na^+ and SO_4^{2-} ions are spectator ions. $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ OR $CuSO_4(aq) + 2NaOH(aq) \rightarrow Cu(OH)_2(s) + Na_2SO_4(aq)$	• Identifies ions in ONE beaker before mixing. • Identifies the beaker with no precipitate. (*Evidence can be found in the table.*) • Writes the name of TWO precipitates. (*Evidence can be found in the table.*) • Writes TWO formulae of precipitates OR correctly writes a word equation. (*Evidence can be found in the table.*)	• Links the colours and formulae to the names of the precipitates. (*Evidence can be found in a fully correct table.*) • Links spectator ions to being soluble. • Links insolubility to the formation of ONE precipitate. • ONE unbalanced equation (all formulae must be correct).	• Justifies the beakers that produce a precipitate and the beaker that does not produce a precipitate, with reference to the formation of insoluble precipitates and spectator ions remaining in solution. • TWO balanced equations (symbol or ionic). (*States are not required in balanced equations.*)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	2a	3a	4a	3m	4m	2e with minor error or omission	2e

Cut Scores

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 10	11 – 18	19 – 24	25 – 32