Assessment schedule – 2017

Chemistry: Demonstrate understanding of aspects of selected elements (90933)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	**Diagrams** showing electron arrangements of 2,8,3 for aluminium and 2,8,6 for sulfur.	• Correct electron arrangements.		
(b)	Aluminium is in Group 13 of the periodic table with an electron arrangement of 2,8,3. It loses 3 electrons from its valence (outer) shell, to form an aluminium ion with an electron arrangement of 2,8 and a charge of +3. The ion has a charge of +3, as it has three more positively charged protons compared to negative electrons. Sulfur is in Group 16 of the periodic table with an electron arrangement of 2,8,6. It gains 2 electrons to fill its valence shell, to form a sulfide ion with an electron arrangement of 2,8,8 and a charge of –2. The ion has a charge of –2, as it now has two more negatively charged electrons compared to positive protons. Atoms lose or gain electrons depending on which group they are in to form an ion with the same electron arrangement as the nearest noble gas (to become more stable).	• Identifies that aluminium loses three electrons OR that sulfur gains two electrons.	• Links the ion formation to the position of the element on the periodic table, and links the valence electrons to electron gain / loss for each element.	• Explains the charges on the ions regarding the position of the element on the periodic table, the number of valence electrons, and the loss or gain of electrons (referring to how the overall charge is produced).

(c)	Calcium reacts vigorously with water to form a metal hydroxide and hydrogen gas. The water goes cloudy / milky as sparingly soluble calcium hydroxide forms, and there is fizzing, which indicates a gas (hydrogen). $Ca(s) + 2H_2O(\ell) \rightarrow Ca(OH)_2(aq) + H_2(g)$ Magnesium does not generally react with cold water unless very clean. (It will react in steam to produce white magnesium oxide and a gas.) Magnesium is not as reactive as calcium because it is further down the activity series / it requires more energy to remove the valence electrons than calcium. Both Ca and Mg will react with dilute HCl. Calcium reacts vigorously to form a metal chloride and there is rapid fizzing, which indicates a gas (hydrogen). The container will get warm. $Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$ Magnesium reacts less vigorously to form a metal chloride and there is fizzing, which indicates a gas (hydrogen). Both metals are in Group 2 of the periodic table, and therefore will react similarly, since they both have two valence electrons. However, since the Ca atom's valence electrons are further away from the nucleus than Mg's valence electrons, Ca is more reactive than Mg, as it will lose its valence electrons more easily.	• Describes an observation for ONE reaction. • Identifies ONE product formed. • Describes the relative reactivity of Ca and Mg.	• Links observations to TWO correct products for one reaction. • Explains the reactivity of Ca and Mg by linking them to their position on the periodic table and their links to valence electrons OR Observations with H_2O or HCl reaction explained for one element. • TWO correct unbalanced symbol equations.	• Compares and contrasts the reactivity by linking to the position on the periodic table AND gives observations for the correct products for the reaction with water and HCl. • TWO correctly balanced equations. (*States are not required*.)

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

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Sulfur: low melting point / brittle / does not conduct electricity / yellow solid. Lead: ductile / malleable / conducts electricity and heat / dense / grey-coloured solid / lustrous (when polished).	• Identifies one property for each element.		
(b)	Zinc is more reactive than iron so will react first protecting the steel / iron. It acts as a sacrificial metal, reacting (oxidising) to dissolve in the sea water, thus protecting the steel / iron. The steel / iron will react only once the zinc blocks have been dissolved, so the blocks must be replaced periodically to protect the hull of the ship.	• Identifies that zinc is more reactive than iron.	• Links the application of zinc blocks to the protection of the steel / iron hull.	• Full explanation as to the function of the zinc blocks including reference to the activity series and that steel will not react until Zn is used up, or the need for Zn to be replaced periodically.
(c)(i)	The process of alloying is used to change the chemical composition of the metal and improve its properties – both physical and chemical, depending on the use.	• Describes a change in physical / chemical composition of the metal.	• Links change in physical / chemical composition to improve properties.	
(ii)	Alloys contain a mixture of metals / elements that can give them desired characteristics. Different alloying elements each have their own effect on the properties of zinc. Zinc is a relatively dense, shiny and malleable metal, suitable for making jewellery. Alloying metals increases the hardness (copper), as alloys contain atoms of different sizes, which makes it harder for the layers to slide over each other. Other elements may also be added to increase resistance to corrosion – they may form a protective oxide layer (magnesium). Aluminium may lower the density (*do not accept lightness*).	• Describes what an alloy is in (c)(i) or (ii). • Identifies a desirable property of the alloy.	• Explains how alloying can result in a desirable property.	• Explains in detail how desirable properties may be obtained by alloying; links must be made for each metal and their properties.

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

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Ammonia is a weak base / soluble in water / less dense than air / colourless gas.	• Two properties stated.		
(b)	Concentrated sulfuric acid is acting as a dehydrating agent. It removes the water from the hydrated copper sulfate, $CuSO_4 \cdot 5H_2O(s)$, which is blue, to form anhydrous copper sulfate, $CuSO_4(s)$, which is grey-white.	• Describes sulfuric acid acting as a dehydrating agent / removes water from copper sulfate.	• Links answer to both observations and the equation.	
(c)	**Chlorine** Chlorine is a pale green gas. The chlorine reacts with the water to form an acidic solution because it is soluble in water. $Cl_2(g) + H_2O(\ell) \rightarrow HCl(aq) + HOCl(aq)$ The solution is acidic due to the increase in the concentration of hydrogen (H_3O^+ / H^+) ions in the solution. The hypochlorous acid, HOCl, acts as a disinfectant and kills any bacteria in the water. Only very small amounts of chlorine are required for this to be effective. The hypochlorous acid acts as an **oxidant** on the bacteria, destroying them. Chlorine requires the addition of chemicals and can leave disinfection by-products that can be very hazardous to health.	• Describes one property of chlorine.	• Links properties of chlorine to its use as a disinfectant.	• Full explanation for chlorine, including balanced chemical equation (*states are not required*)
	Ozone Ozone is a colourless gas. Ozone, O_3, can be used to purify water because it is a powerful oxidising agent and it is soluble in water. It interferes with the biological processes of micro-organisms in the water, and also changes dissolved impurities, such as iron / manganese, into an insoluble form so they can be filtered out of the water. The ozone forms O_2 and so the drinking water is safe to drink. $O_3 \rightarrow O_2 + O$ The use of ozone requires not only power, but also is such a strong oxidiser that it tends to destroy the plumbing used to dispense it. Ozone is also unstable, so it must be made on-site as it cannot be	• Describes one property of ozone.	• Links properties of ozone to its use as a disinfectant. • ONE correctly balanced symbol equation.	• Full explanation for ozone, including balanced chemical equation. (*states are not required*)

	stored for a long time or transported.			

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24