Assessment Schedule – 2021

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

Evidence Statement

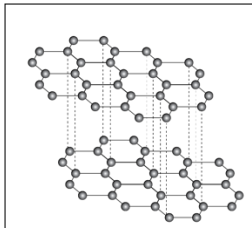
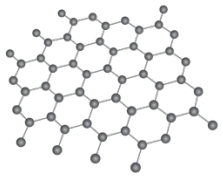
Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Elements form ions to complete their valence electron shell and become more stable. The charges on sodium ions and fluoride ions differ because sodium is a metal in group 1 of the periodic table, and fluorine is a non-metal in group 17 of the periodic table. Sodium atoms have one valence electron, which they lose to form sodium ions with a charge of 1+, Na^+, since the ions have one more positive proton than negative electrons. Fluorine atoms have 7 valence electrons, so they gain 1 electron to form fluoride ions with a charge of 1–, F^-, since the ions have one more negative electron than positive protons.	• Identifies that Na loses 1 electron / forms a 1+ ion. OR Identifies that F gains electrons / forms a 1– ion. • Describes why atoms form ions, with reference to stability or full valence electron shell.	• Links position on the periodic table to the loss / gain of electrons. OR The number of valence electrons to the charge on the ion formed.	• Explains why ions form (stability via a full valence shell) and the differences in the formation of each ion with respect to position on periodic table. AND Electron gain / loss and the charge of the ion formed.
(b)(i)	Sodium metal is very reactive, and able to react quickly with oxygen in the air to form sodium oxide, Na_2O. The sodium oxide forms on the surface of the metal, causing it to dull.	• Sodium reacts with oxygen.	• Explains reaction with links to species and observations.	
(ii)	Lithium + water → lithium hydroxide + water $2Na + 2H_2O \rightarrow 2NaOH + H_2$	• Word equation completed correctly (ii). • Correct unbalanced equation (ii) or (iv).	• Both equations (from (ii) and (iv)) correctly completed.	
(iii)	Lithium's density is less than that of water, so it floats on the surface, gently fizzing and giving off hydrogen gas. It gradually reacts and disappears, forming a colourless solution of lithium hydroxide. The reaction generates heat slowly. (Lithium's melting point is too high for it to melt.) Sodium also floats on the surface, but enough heat is given off to melt the sodium (sodium has a lower melting point than lithium and the reaction produces heat faster) and it melts almost at once to form a small silvery ball that dashes around the surface. A white trail of sodium hydroxide is seen in the water under the sodium, but this soon dissolves to give a colourless solution of sodium hydroxide. The sodium moves because it is pushed around by the hydrogen which is given off during the reaction. If the sodium becomes trapped on the side of the container, the hydrogen may catch fire to burn with an orange flame. The colour is due to contamination of the normally blue hydrogen flame with sodium compounds.	• An observation for one reaction.	• Two observations for one reaction linked to the species.	• Two observations for each reaction linked to the species. AND Correct balanced equation for either (ii) OR (iv).
(iv)	$2Na + H_2SO_4 \rightarrow Na_2SO_4 + H_2$			

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
TWO (a)	Same number of electrons in the outer shell (Box 2): Elements are placed in the same group of the periodic table due to their number of valence electrons. Similar chemical reactions (Box 4): Magnesium and calcium both have two valence electrons, which means they have similar chemical reactions because they both lose two valence electrons to become more stable.	• One correct box ticked.	• Two correct boxes ticked with valid explanations.	
(b)(i)	Mild steel is harder than iron and so gives more strength to the car body panels. The carbon atoms in mild steel are a different size to the iron atoms and so they distort the layers of atoms in the pure iron. This means that it is more difficult for the layers to slide over each other in mild steel, so it is harder than pure iron. Car body parts are often painted and protected from high temperatures, oxygen, and water, so mild steel can be used without needing the chemical resistance seen in stainless steel. Stainless steel is also harder than iron due to the different sized carbon, chromium, and nickel atoms distorting the layers of iron – so gives more strength to the exhaust pipes than pure iron. Pure iron is prone to rusting since it reacts with oxygen and water to form iron oxide which flakes off and would eventually degrade the pipes. The chromium and nickel in stainless steel react with oxygen and water to form a stable oxide film that prevents further corrosion.	• Mild steel is harder and / or stronger than pure iron. OR Stainless steel is harder and / or stronger than pure iron. • Pure iron rusts. OR Stainless steel is more resistant to corrosion. • Correct diagram (including labels)	• Links mild steel / stainless steel to being harder due to substitution of some iron atoms with carbon / chromium and nickel atoms. • Links rusting of iron to flaking and degradation of exhaust pipes. OR Links stainless steel corrosion resistance to stable oxide film.	• Correct explanation of increased hardness, linked to substitution of some iron atoms with carbon atoms in mild steel, and chromium and nickel atoms in stainless steel. AND Explains increased corrosion resistance of stainless steel.
(ii)	Aluminium is most likely to be used for all of the purposes. Both aluminium and copper could be used for power cables because they are both good conductors of electricity, and are both ductile, so can be drawn into wires. Aluminium is more likely to be used for aircraft bodies than copper because although they are both resistant to corrosion, aluminium has a lower density and so will be lighter and more suitable for aircraft. Both copper and aluminium are good conductors of heat and are malleable and so can be used for saucepans.	• Identifies one chemical or physical property of each metal. • Identifies Al as most suitable.	• Links the suitability of one metal to two uses. OR Links suitability of one metal to both a chemical and a physical property.	• Identifies the most likely metal with justification for **each** use, including why copper is not likely to be used for aeroplane bodies. Comparison for each and identify why Al is best for aircraft bodies.

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

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Chlorine, Cl_2, dissolves in water to form an acidic solution (pH less than 7). Cl_2 reacts with H_2O to form HOCl (hypochlorous acid) and HCl (hydrochloric acid). Both compounds separate to form H^+ (H_3O^+) ions in solution, which are responsible for the lower pH. $Cl_2 + H_2O \rightarrow HOCl + HCl$ Ammonia, NH_3, dissolves in water to form a basic solution (pH greater than 7). NH_3 reacts with H_2O to form NH_4OH (ammonium hydroxide) which separates into NH_4^+ and OH^- ions. The OH^- ions produced are responsible for the higher pH. $NH_3 + H_2O \rightarrow NH_4OH$ ($NH_4^+ + OH^-$) Ozone, O_3, dissolves in water, and while it can decompose to form oxygen gas (O_2), neither gas reacts with water to form acidic or basic substances. The solution of ozone is neutral (pH equal to 7).	• Correct reason given for observed pH of ONE solution. • Correct pH identified for all 3 solutions.	• Correctly explains observed pH of TWO solutions. • ONE correct equation.	• Justifies observed pH of all THREE solutions. AND BOTH balanced chemical equations correct.
(b)(i)	• unreactive • gas at room temperature • colourless • odourless	• TWO correct.		
(ii)	Nitrogen can be used as a refrigerant as it is unreactive and has a low boiling point. It is safe to use as a liquid and does not contaminate or react with any of the cells being stored, and boils straight into the atmosphere without leaving any residue behind. Nitrogen can be used as a fire suppressant as it is unreactive, does not combust, and will not damage the electrical equipment like water might. It will lower the oxygen content in the air, enabling the extinguishing of any fires. Nitrogen can be used in food packaging as it odourless and unreactive, creating an inert atmosphere inside the packaging, preventing spoilage that would occur due to oxidative damage by oxygen in the air, without changing the taste of the food.	• ONE use linked to property.	• TWO uses explained with links to properties.	

(c)(i)	 graphite  graphene	• Both correct.		
(ii)	Graphite and graphene can conduct electricity because each C atom is bonded to three other C atoms, which means each C atom has a free delocalised electron which is able to move and carry charge.	• Each C atom bonded to three other C atoms. OR Free electrons can carry charge.	• Explains why graphite and graphene can conduct electricity.	• Explains why graphite and graphene can conduct electricity, and why graphite can be used in lubricants and pencil leads but graphene cannot.
(iii)	Graphene is made up of one layer of carbon atoms compared with the 2D structure of graphite. Graphite is made up of layers, which slip over each other (due to weak attractions between them), so it is suitable as a lubricant, and in pencil leads. Graphene is unsuitable, as it consists of one layer.	• Description of graphene and graphite.	• Explains why graphite is suitable.	

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

Cut Scores

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