Assessment Schedule – 2020

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i) (ii)	**Calcium**: solid at room temperature / high melting point / high boiling point / relatively soft / low density / (moderate) electrical and heat conductor. Calcium metal burns quite fast with oxygen when strongly heated to form a white powder (calcium oxide). Or slow reaction of Ca with oxygen in air at room temperature to form a white powder. Calcium metal reacts readily with cold water forming bubbles of colourless (hydrogen) gas and a milky suspension / precipitate (of calcium hydroxide). Calcium metal reacts readily / very rapidly/ *vigorously* with dilute hydrochloric acid, forming bubbles of colourless (hydrogen) gas and colourless (calcium chloride) solution. Test tube gets warm / hot. $2Ca + O_2 \rightarrow 2CaO$ $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ $Ca + 2HCl \rightarrow CaCl_2 + H_2$	• Gives one physical property of Ca. • Describes an observation for ONE reaction. • Identifies ONE product formed.	• Links observations to TWO correct products for one reaction. • TWO correct unbalanced symbol equations.	• Gives observations for the correct products for the reaction with water HCl and oxygen and refers to different reactivity. AND TWO correctly balanced equations. (States are not required.)
(b)	Diamond and graphite are both allotropes; different forms of carbon – they are both composed only of carbon atoms, but the arrangement of atoms is different, leading to different structures. Diamond has a giant covalent structure in which each carbon atom is joined to four other carbon atoms by covalent bonds. The carbon atoms have a regular lattice arrangement and there are no free electrons. The carbon atoms in diamond have a (tetrahedral) (pyramid-shaped) arrangement. Graphite has a giant covalent structure in which each carbon atom is joined to three other carbon atoms by covalent bonds. The carbon atoms form layers with a hexagonal arrangement of atoms. The layers have **weak forces** between them and each carbon atom has one non-bonded, free outer electron, (which becomes delocalised). The rigid structure of diamond, held together by strong covalent bonds, makes diamond very hard. This physical property makes diamond useful for cutting tools, such as diamond-tipped glass cutters and oil rig drills. Diamonds are also used in jewellery because they polish well and because of their hardness they are not scratched easily. In graphite, delocalised electrons are free to move through the structure, so graphite can conduct electricity. This makes graphite useful for electrodes in batteries and for electrolysis. The layers in graphite can slide over each other because the forces between them are weak. This makes graphite slippery, so it is useful as a lubricant.	• Identifies diamond and graphite as allotropes. OR Identifies both made of carbon. • One correct description for each allotrope. OR One correct use for each allotrope. OR One correct description for one allotrope and one correct use for one allotrope.	• Explains different structures but same atoms. • Links use to relevant structure and properties for one allotrope.	• Compares and contrasts the properties and uses of both allotropes.

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)	Water is chlorinated to make it safe for swimming in the pool water. 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.	• Describes the solution as being acidic. • Describes why chlorine is added to swimming pool water. • Gives one product of the reaction.	• Explains why chlorine is added to water. • Explains why the solution is acidic. • Correct equation.	• Full explanation, including balanced chemical equation. *States are not required.*

(b)(i)	Nitrogen: 2, 5 N^{3-}: 2, 8	• Correct electron arrangement for nitrogen atom. • Correct electron arrangement for nitrogen ion.		
(ii)	Metals are found on the left-hand side of the periodic table and non-metals on the right. Metals form positively charged ions and non-metals form negatively charged ions. When non-metals form ions, they gain electrons to form a stable outer / valence shell – and a negatively charged ion forms since there are now more negatively charged electrons than positively charged protons. For example, nitrogen gains 3 electrons to form N^{3-} ions. When metals form ions they lose electrons to form a stable outer / valence shell – and a positively charged ion forms since there are now fewer / less negatively charged electrons than positive protons. For example, calcium loses 2 electrons to form Ca^{2+} ions.	• Describes non-metal and metal positions on periodic table.	• Using N as example links non-metals to gain of electrons. OR Named example metal to loss of electrons.	• Full comparison of formation of non-metal and metal ions, for nitrogen ion and a correct (named) metal ion.
(iii)	Colourless Gas	• Identifies colour of nitrogen. OR Identifies state at room temperature.		
(iv)	Nitrogen can be used in food preservation. As it is a gas it can be used to displace air in packaged food. Replacing the air with nitrogen gas prevents microorganisms growing and spoiling the food. Nitrogen is also used to provide a pressurised atmosphere to prevent packages collapsing. At room temperature it is a gas so can be added to packages – this protects delicate foods from being crushed. Nitrogen is a liquid at –196 °C so it can be used to flash-freeze things. It can be used to make ice-cream by pouring the liquid into the mixture.	• Describes one use of nitrogen.	• Links a given use of nitrogen to the relevant properties.	

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No response; no relevant evidence	1a	3a	4a	5a	3m	4m	1e	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	Na^+: 2, 8 K^+: 2, 8, 8	• Correct electron arrangement for sodium ion OR Correct electron arrangement for potassium ion.		
(ii)	Both sodium and potassium have +1 charges. They are both in group 1 of the periodic table as they have 1 electron in their outer shell. When they form ions, they lose the outer electron, so they have one more positively charged proton than negatively charged electrons – giving them an overall charge of +1.	• Identifies that Na loses 1 electron / forms a 1+ ion. OR Identifies that K loses 1 electron / forms a 1+ ion.	• Links position on the periodic table to the loss of electrons. OR The number of valence electrons to the charge on the ion formed.	
(iii)	Sodium and potassium metals are very reactive with oxygen and with water – they react quickly and violently. Therefore, they are not suitable to be used for wiring or casing as they would react with the oxygen in the air around them, or any water that comes in contact with them.	• Identifies that sodium and potassium react readily with oxygen. OR Identifies that sodium and potassium react readily with water.	• Links reactivity of sodium and potassium to spontaneous reaction with oxygen in air, or with water.	

(b)(i)	Copper is useful as wiring as it is strong and ductile so it can be stretched out into wires that will not break when they are bent or flexed. It is also a very good conductor of electricity (6.0×10^7 S / m). Copper also has a high melting point which means it is safer to use to make wires than many other conductive metals because they melt at high temperatures, reducing the risk of electrical fires. Lead has a relatively low melting point for a metal and is soft. So, it can be melted to join two other metals (solder) in the electronic components together – it can be melted at a temperature that will not melt the other metals being joined. Aluminium has a low density, so it is light and won't make the battery too heavy. It also allows thermal conductivity so that the battery does not get too hot or cold. Because it is malleable it can be made into the casing shape and because it is relatively hard it will protect the battery from impact.	• Identifies a relevant property of copper. OR Identifies a relevant property of lead. OR Identifies a relevant property of aluminium.	• TWO of: Links TWO named and relevant properties to uses for copper. OR Links TWO named and relevant properties to uses for lead. OR Links TWO named and relevant properties to uses for aluminium.	• Comprehensively discusses how the properties of these metals relate to their uses in mobile phones.
(ii)	Alloys contain a mixture of metals / elements that can give them desired characteristics. The process of alloying is used to change the chemical composition of magnesium and improve its properties. Magnesium is a very light metal since it has a low density. Alloying metals increases the hardness, as alloys contain atoms of different sizes, which makes it harder for the layers to slide over each other. Different alloying elements each have their own effect on the properties of magnesium. Aluminium increases the strength due to its hardness and increases its corrosion resistance since it forms an oxide layer when it reacts with air. Zinc is denser and more malleable so could be added to make it harder and easier to shape into a case. Other elements may be added to increase resistance to corrosion since magnesium reacts with air and water.	• Describes the structure of the alloy. • Identifies a relevant property of magnesium. OR Identifies a relevant property of the magnesium alloy. • Labelled diagram showing different-sized atoms.	• Explains how a desirable property can be obtained by alloying. • Gives an example of a physical or chemical property of aluminium or zinc (or other metal) linked to its usefulness for improving the alloy used in mobile phone casing.	• Comprehensively discusses why magnesium alloy is used rather than pure magnesium metal for mobile phone casings.

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19 – 24