Assessment Schedule – 2008

Chemistry: Describe characteristic properties and reactions of metals, acids and bases (90640)

Evidence Statement

Question	Evidence	Achievement	Merit	Excellence
ONE (a)	red / red-orange / orange green / green-blue / blue blue-purple / purple	TWO of three colours correct.		
(b)	Type of reaction: The reaction is acid-base / acid-carbonate / neutralisation. (OR "the reaction is between ethanoic acid, an acid and sodium hydrogen carbonate, a base" or equivalent.) Observations: Fizzing / bubbling / frothing / foaming / effervescence would be observed as CO_2 gas is produced. The sodium hydrogen carbonate would disappear / dissolve. Word equation: (must be all in words – no formulae) Sodium hydrogen carbonate (or sodium bicarbonate) + ethanoic / acetic acid → sodium ethanoate / acetate + water + carbon dioxide. Balanced equation: $NaHCO_3 + CH_3COOH \rightarrow CH_3COONa + H_2O + CO_2$ ($NaCH_3COO$ also accepted.)	TWO of • Correct type of reaction • ONE observation • Identifies the three products by correct name and / or formulae.	Correct type of reaction AND describes the fizzing OR disappearing of the solid AND Writes correct word equation OR an incorrectly balanced equation. (BUT all chemical formulae must be correct.)	Correct type of reaction AND describes fizzing as a consequence of the CO_2 gas being given off AND a balanced chemical equation. (States are NOT required.)

TWO (a) (i)	Fizzing / bubbling / effervescence • Explanation: hydrogen / H_2 / gas is produced Litmus / water / solution turns blue or blue-purple / purple-blue • Explanation: an alkaline solution / alkali is produced / $Ca(OH)_2$ forms / OH^- ions formed / base produced / basic substance produced White solid forms / white precipitate / solution goes milky / white / cloudy • Explanation: calcium hydroxide is not very soluble / is insoluble / it forms suspension. Calcium / metal disappears / dissolves • Explanation: has formed a compound in solution / forms a solution / has reacted with the water / forms product that dissolves / disperses in the water Beaker / beaker contents / water / solution : get warmer / hot • Explanation: exothermic reaction / reaction releases heat energy Ca pieces sink, float up, sink (and cycle repeats) • Explanation: light H_2 gas forms on Ca & helps it floats up etc (but **not** floats / fizzes around surface)	TWO correct observations described.	TWO observations & explanations for the correct observations.	
(ii)	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ (States are NOT required.)	Correct formulae of BOTH reactants and products.	Correctly balanced equation.	

(b)	X is sodium because it is shiny grey and the reactions with oxygen, water and acid are all very strong / vigorous. Sodium is the only metal in the list that has such vigorous reactions. It is high in the activity series. Sodium reacting with oxygen in air would produce **sodium oxide**. Sodium reacting with water would produce s**odium hydroxide and hydrogen** gas. Sodium reacting with acid would produce **sodium sulfate and hydrogen** gas. Y is copper because it is pink-brown in colour and has no reaction with oxygen, water or acid, reflecting the position of copper on the activity series. Copper is a very unreactive metal. Z is magnesium because it is shiny grey and it burns with a characteristic / distinctive bright (white) light in oxygen to form **magnesium oxide**. It has a relatively high position in the activity series but is not as reactive as metal X/Na. Magnesium reacting with water would produce **magnesium hydroxide and hydrogen** gas. Magnesium reacting with acid would produce **magnesium sulfate and hydrogen** gas. Answers may be justified by using knowledge such as Mg is used in flares and fireworks because it burns with a bright white flame. (Equations can be used to identify products. They do not have to be balanced. However, if formulae are used they should be correctly written.)	TWO metals are correctly identified AND ONE characteristic reaction or property is described for EACH correct metal. Note: Must not just be reiteration of information from the table; It should also be linked to the relative reactivity of the element, a specific reaction or the distinctive colour of Cu.	ALL THREE metals are correctly identified AND Characteristic reactions (or lack of) are explained to justify the selection of Na and Cu & Mg. AND product(s) of three reactions are correct: Allow metal oxide, metal salt and metal hydroxide.	
THREE (a)	The reaction has stopped / slowed down / no more gas is produced. The reactants are being converted into products. This means there are fewer / no reactant particles available to collide as the reaction progresses. The rate of the reaction will decrease and eventually the reaction will stop. Incorrect chemistry referring to changes in energy or speed of particles or "gas levelling off" or changes to activation energy negated some answers.	Recognises that reaction has stopped / is no longer occurring or no more gas is produced or gas is being produced more slowly / reaction has slowed down.	As Achievement plus explains the lack of reactant / named <u>particles</u> left to <u>collide</u> in the reaction as Mg (or acid) disappears; the idea of rate of collisions or production of gas getting less as time goes on must be clearly implied / stated.	

(b)	The reaction rate will increase. There are more reactant particles <u>immediately available</u> to react because the surface area of the powder is greater than that of the ribbon. There is greater exposure of the magnesium particles so more can collide at any one time. This means there will be more (effective) collisions per second / more frequent collisions between the Mg / powder and the acid, leading to an increase in the rate of the reaction.	Identifies that the rate of reaction will increase / the reaction will be faster AND describes greater / increased / larger surface area of powder.	Explains how the increase in the rate of reaction relates to the greater surface area provided by the magnesium powder – <u>idea of more exposed surfaces</u> for <u>reactions/collisions</u> to occur on / more Mg particles available at one time OR Links the increase in the rate of reaction to the greater surface area provided by the magnesium powder leading to an increased frequency of collisions.	Discusses how an increased surface area (more exposed Mg particles at one time) increases the rate of a reaction in terms of the frequency of the collisions between the magnesium and acid particles.

FOUR	Aluminium is very malleable, and able to be shaped without cracking, into cans or foil. Aluminium has low density. This gives aluminium its unique lightweight property which keeps costs low for transportation and packaging. (of large numbers of cans or foil dishes or rolls.) Aluminium forms a (very thin) oxide coating, Al_2O_3, which forms a protective layer, making the metal very corrosion resistant and durable. It is ideal for using in food and drink packaging. So despite the fact that aluminium is quite high on the activity series, it is unreactive due to its oxide coating which prevents the metal from reacting with the food / drink / named substance(s). Aluminium is easily recycled, using less energy than that originally used to extract it, so makes it a more sustainable metal than many others. Aluminium is also completely impermeable; (even when rolled into extremely thin foil), and also doesn't let the aroma or taste out of food packaging, the metal is non-toxic and aroma-less itself too, making it perfect for packaging. Aluminium foil acts as a barrier to moisture, preventing loss of moisture that may result in a less appealing texture of foods. Aluminium is a good conductor of heat which is important when wrapping food in it for cooking so heat energy can get through. Aluminium foil is a poor emitter and absorber of radiation, and a good reflector of radiation, so cold food wrapped in foil won't heat up that fast / hot food wrapped in foil won't cool down quickly. Aluminium has a relatively high melting point which is important when wrapping food in it for cooking so it doesn't melt.	TWO correct properties identified for use in packaging. • Light / lightweight, low density • Malleable • Good conductor of heat • Relatively high melting point • Shiny / reflective surface / has lustre • Poor emitter / absorber of radiation, / good reflector of radiation. • Recyclable • Impermeable • Doesn't corrode / react with (named) substances(s) • Metal / Al doesn't corrode due to the oxide layer. (Properties must be relevant to use, ie do not accept good electrical conductivity or ductility since the question clearly referred to sheets of metal / foil.)	TWO correct properties (chemical and/or physical) identified for use in packaging AND Explains why these two properties make the aluminium suitable for this use OR Any 2 relevant properties (other than lack of apparent reactivity) are identified AND also explains how the aluminium oxide layer / oxide stops the Al / metal from reacting with *named* substance(s) (either inside or outside the packaging).	TWO correct physical properties (other than lack of apparent reactivity) identified for use in cans or foil packaging AND Explains why these two properties make the aluminium suitable for this use AND Explains that the metal / aluminium has an oxide coating that stops / protects the Al / metal below from reacting / coming into contact with *named* substance(s) (either inside or outside the packaging).

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Total of SIX opportunities answered at Achievement level or higher OR FIVE opportunities including ONE Merit or higher. $6 \times A$ or $1 \times M + 4 \times A$	Total of at least SIX opportunities answered with FOUR at Merit level or higher. $4 \times M + 2 \times A$	Total of at least SIX opportunities answered with TWO at Excellence level and THREE at Merit level or higher. $2 \times E + 3 \times M + 1 \times A$