Assessment Schedule – 2023

Science: Demonstrate understanding of aspects of acids and bases (90944)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	Sodium hydroxide	• Circles sodium hydroxide.		
(ii)	To neutralise the acid, a base is needed. Ethanoic acid is not a base, so will not neutralise the acid. Sodium hydroxide is a base, so will neutralise the acid.	• Identifies sodium hydroxide will neutralise the acid. OR Identifies ethanoic acid will not neutralise the acid.		
(b)	As the temperature of the hot acidic paru / mud increases, the particles move faster and have more (kinetic) energy. There are more collisions per second between the acid (and the flax particles) due to higher speed, and more of these collisions have enough energy to cause a reaction. Therefore, increasing the temperature will cause more successful collisions per second, and the reaction (dying process) will occur faster.	• Increasing temperature causes more (frequent) collisions. OR Particles have more energy / move faster. OR Vice versa. • Describes collision theory e.g. reaction occurs when particles collide successfully. OR More (successful) collisions per second cause a faster rate of reaction (vice versa).	• Explains that acid particles at the higher temperature will have more energy, so there will be more successful collisions. • Explains that acid particles at the higher temperature move faster, so will have more frequent collisions / collisions per unit time.	• Fully explains that at high temperatures, acid particles will collide with more energy / force, producing more successful / effective collisions between acid and flax. AND Because the particles have more kinetic energy and move faster, there will be more frequent collisions / collisions per unit time, which will increase / speed up / cause a faster rate of reaction.

(c)	Calcium becomes stable by losing / transferring two electrons (to the oxygen atom), forming an ion with a charge of +2. The oxide ion, formed by the gain / transfer of two electrons (from the calcium atom), has a charge of –2. The Ca^{2+} ion requires the equivalent of two negative charges to form a neutral compound, so one oxide ion with a 2– charge is required to cancel out the 2+ charge on the calcium ion. This 1:1 ratio of ions is represented in the formula as CaO.	• States that Ca atom loses (two) electrons. OR O atom gains (two) electrons. • (Ion) Charges cancel / balance to make a neutral compound (compound with neutral/ zero charge/ no charge).	• Explains that Ca needs to lose two electrons OR O needs to gain two electrons to become stable/ full valence shell. • Calcium ion has a charge of +2 and oxide has a charge of –2 so the charges on the ions cancel each other / neutral compound.	• Fully explains that two electrons from the calcium **atom** are transferred to the oxygen atom to form stable ions and a neutral compound. AND Explains the 1:1 ratio of the **ions** is caused by the ions having equal sized but opposite charges so the positive charge cancels / (are balanced with) the negative charges to form a compound with neutral/ zero charge/ no charge.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	TWO Merit points.	THREE Merit points.	One Excellence point.	Two Excellence points.

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	Powdered (māhoe) ash.	• Powdered (māhoe) ash.		
(ii)	For a reaction to occur, reacting particles must collide. The powdered ash has more surface area for the hydrochloric acid to collide with. There is more chance of the acid colliding with a reactant particle, so there are more reactant collisions per second / happen more frequently, so the rate of reaction increases / gets faster / goes up.	• Describes collision theory. (only given if not in Q1 AP4) • The powdered ash has more surface area/more particles exposed. OR Converse. • The powdered ash has a higher rate of reaction / more collisions. OR Converse.	• Explains that the powdered ash has a greater surface area, and so more surface area for the acid particles to collide with / available for a reaction. (Must talk about acid / reactant particles) • Explains that the more frequent collisions increase the rate of reaction and links to production of carbon dioxide/gas or loses mass faster.	• Explains that the powdered ash has a greater surface area for the HCl / acid particles to collide with. There is a greater chance of collisions occurring per unit time / more frequent collisions / collisions happen more often, so increase rate of reaction. AND Explains that the samples contained the same mass / amount of reactant particles ash to react with the HCl. This produced the same mass of carbon dioxide / gas and the **same mass lost.**
(iii)	The mass (amount) of powered ash was equal to the mass (amount) of ash chunks. The reaction will occur until the ash has been fully reacted / completely formed the products. This will be the same for both powder and chunks, so the final masses will be the same due to loss of same mass of carbon dioxide.	• States that the same mass of ash / reactants was in each sample. Accept same 'amount' / both 1 kg etc or the same amount of carbon dioxide / gas/products was produced for both.	• Explains that the samples contained the same mass / amount of reactant particles of ash to react with the HCl. This produced the same mass of carbon dioxide/ gas.	

(b)	*In discussion accept H^+ or H_3O^+.* As the HCl is added, the basic solution / alkali is being neutralised as water is formed. Before the HCl is added, the solution is blue with a pH of **8–11**. There is an excess of OH^- ions. When the numbers of H^+ and OH^- ions are equal, the solution is neutralised, green, and the pH is 7. As more HCl is added, the solution becomes yellow, with pH of 5-6. There is a small excess of H^+ ions. As more HCl is added, the solution becomes orange, with pH of 3-4. There is a larger excess of H^+ ions. As more HCl is added, the solution becomes red with a pH of 1–2. There is a significant excess of H^+ ions.	• Links two pH values to correct colour. • Identifies that OH^- ions are neutralised as H^+ ions are added. • At pH 7 / green / neutral, – acid and base cancel out. OR $H^+ = OH^-$ at pH 7.	• Explains that before any HCl is added, the OH^- ions are in excess, and as more HCl is added, the concentration of H^+ ions increase until H^+ ions are in excess. • Explains that once a sufficient number of H^+ ions have been added to neutralise all the OH^- ions (to form water), the pH equals 7 and the solution is neutral. • Links FOUR UI colours (red, yellow / orange, green, blue) to EITHER correct pH values OR relative concentrations of ions present.(table)	• Fully explains and links the colour changes to the changing pH, relative concentration of H^+ ions and OH^- ions present, and at pH 7, $H^+ = OH^-$ and neutral substances/water made (neutralisation reaction).
(c)	Sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$. potassium carbonate + hydrochloric acid → potassium chloride + water + carbon dioxide $K_2CO_3 + 2HCl \rightarrow 2KCl + H_2O + CO_2$.	• ONE correct word equation.	• Correct formulae for ONE symbol equation, but not balanced.	• ONE correctly balanced symbol equation

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	TWO Merit points.	THREE Merit points.	Two Excellence point.	Three Excellence points.

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	K atom: 2,8,8,1 P atom: 2,8,5	• Correctly gives the electron arrangement of ONE atom.		
(b)(i)	Both ions have the electron arrangement 2,8,8.	• States the electronic arrangement of the ions.		
(ii)	K^+ because it has 19 + protons (+ve charges) and only 18 – electrons (–ve charges). It had only 19 electrons as an atom and its electron arrangement was 2,8,8,1, and when it forms an ion, it loses one electron to form an arrangement of 2,8,8 to have a full outer shell, which is more stable. P^{3-} because it has 15+ protons (+ve charges) and 18 – electrons (–ve charges). It had 15 electrons as an atom and its electron arrangement was 2,8,5 and when it forms an ion, it gains three electrons to form an arrangement of 2,8,8 to have a full outer shell, which is more stable.	• Defines an ion, e.g. an atom that has gained or lost an electron to become stable / has a full outer shell. • States that K atom loses (one) electron. OR P atom gains (three) electrons.	• Explains that K needs to lose one electron, and P needs to gain three electrons for each to have a full outer shell / be stable. • Explains the charge on ONE ion in terms of electron arrangement AND atomic structure (eg 19 protons and 18/ one less electron/s). • Explains the charge on both ions in terms of the balance of **+ protons** and **– electrons** in the ion.	• Fully explains that K atom has 19 + protons and 19 – electrons with electron configuration of 2,8,8,1. It has one electron in its valence (outer) shell so needs to lose it to have a full outer shell to become stable. It now has 1 less e– (-18e) than p+ (+19p) the electron configuration of the ion is 2,8,8 to become K^+. AND P has 15 + protons and 15 – electrons and has an electron configuration of 2,8,5. It needs to gain 3 electrons to get a full outer shell and be stable. It now has 3 more electrons(-18e) than protons(+15p) and an electron configuration of 2,8,8 and so is P^{3-}.

(c)(i)	More concentrated.	• Correct answer circled.		
(ii)	When more concentrated acid is used, there are more acid particles / H^+ ions in the same volume of the acid. Because of this, there are more particles available to collide with the calcium carbonate particles. Because there are more to collide, more successful collisions occur per second or per unit time, and the rate of reaction is faster.	• Describes collision theory, e.g. Particles collide / hit / at the correct orientation with enough energy. (only given if not in Q1 AP4 or Q 2 AP1a) • More concentrated acid has more acid / H^+ particles to react. • Reaction rate is faster with increased concentration.	• Explains that by increasing the concentration of the acid /in the more concentrated acidic rain, there are more acid particles present to collide (successfully) so the reaction rate is faster.	• Fully explains why the reaction is faster, by linking the ideas that there are more acid particles in the same unit volume / per volume available for more successful collisions with Calcium carbonate particles, and hence there will be more frequent collisions / collisions per second / collisions per unit time, causing the faster reaction rate. Context – Acid and calcium carbonate. (*Needs to link ideas of increased concentration to more particles per volume for more successful collision per second / frequency of collisions resulting in increased / faster the rate of reaction.)*

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	TWO Merit points.	THREE Merit points.	ONE Excellence points.	TWO Excellence points.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 19	20– 24