Assessment Schedule – 2017

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

Evidence Point

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	A gas / carbon dioxide released.	• States fizzing caused by gas (carbon dioxide) release or reaction / collision of the 2 named reactants.	Explains that the amount of reactants is highest at the start, so there are more particles present and therefore there is a greater frequency of collisions or collisions slow as reactants used up.	• Explains that the concentration of reactants is highest at the start, so there are more particles present and therefore there are more collisions occurring per unit time / collisions are more frequent and decrease as reactants decrease as reaction proceeds.
(b)	The concentration of reactants is highest at the start of the reaction, i.e. greatest number of reactant particles per unit volume at the start. As a result, there is a higher frequency of successful / effective collisions at the start and therefore a faster rate of reaction than later as reactants run out.	• States that at the start of the reaction there is the highest number of reactants / more particles available to react. • More collisions at the start OR particles are used up during the reaction. Collision theory description.	• Explains that when there is a higher temperature, the reactants move faster so greater collision frequency.	• Fully explains that the reaction is faster at the higher temperature, because the particles have more kinetic energy / move faster. Therefore, there will be more frequent collisions, and these collisions will be more effective, as the particles will collide with more energy and same end point as same reactant mass.
(c)	As the temperature increases from 30°C to 55°C, the reactant particles gain kinetic energy, i.e. the average kinetic energy of particles increases. This causes the particles to move more quickly, and therefore increases the frequency of collisions. In addition, more of the collisions are effective / successful because the particles have more energy / force. This leads to a faster rate of reaction. Since the same amounts of each reactant are used at both temperatures, the total volume of gas produced is the same for each temperature, and therefore both lines finish at the same point.	• At higher temperatures reactants move faster OR there are more collisions. • Both lines finish at same point as both reactions produce the same volume of gas. OR same amount of reactants so same amount of products (at the end).	• Explains collide with more energy / force, and therefore more successful collisions occur per unit time. • Explains from graph that the same volume / amount of gas is produced at both temperatures as there was the same amount of reactants at the start.	
(d)	Sodium hydrogen carbonate + sulfuric acid → sodium sulfate + water + carbon dioxide $2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2$	• Correct word equation.	• Correct formulae for symbol equation, but not balanced.	• Correctly balanced symbol equation.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	Any ONE point.	Any TWO points.	Any THREE points.	Any FOUR points.	TWO points.	THREE points.	TWO points.	ALL THREE points

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)	Sodium and potassium are both in Group 1 of the periodic table. This means they each have one valence electron. Their atom electron arrangements are shown below: Na atom: 2, 8, 1 K atom: 2, 8, 8, 1 The Na and K atoms will each lose their one valence electron to gain a stable full outer shell, as shown by the ion electron arrangements below: Na^+: 2, 8 K^+: 2, 8, 8 Oxygen is in Group 16 of the Periodic Table. This means it has six valence electrons. Its atom electron arrangement is: O atom: 2, 6 The O atom will gain two electrons to gain a stable full outer shell, as shown by the ion electron arrangement below: O^{2-}: 2, 8 Since Na and K each lose one valence electron whereas O gains two electrons, Na and K can transfer electrons to the O atom. This transfer of electrons causes ions to form; the electrostatic attraction between the oppositely charged ions (Na^+ and O^{2-}, and K^+ and O^{2-}) is called an ionic bond. Each O atom will need to react with two K / Na atoms to get the two electrons it needs. The Na and K atoms cannot react with each other because they each react by losing one electron. Therefore, electron transfer cannot occur between the Na and K atoms.	• Correctly gives the electron arrangement or groups of EITHER two atoms OR two ions. • States that Na and K each lose one electron, and O gains two electrons when forming ions. • Gives a reason K and Na can't react with each other . • Recognises charges need to cancel out / balance OR electron transfer for ionic bond. *Formation of **ionic bond** between K **or** Na and O required; not both.*	• Explains that Na and K are both Group 1 elements and will therefore have one valence electron, whereas O is in Group 16 (6) and therefore has six valence electrons. • Explains that Na and K will each lose one valence electron to gain a full outer shell, whereas O will gain two valence electrons to gain a full outer shell. • Explains that Na and K can't react as electron transfer cannot occur between since they both lose one electron, so an ionic bond cannot form. OR no (electrostatic) attraction as both positive ions and need negative and positive for ionic bond.	• Fully explains that Na and K will each lose one valence electron as Group 1 elements; these valence electrons can be gained by a O atom since Group 16 (6) elements gain two electrons to gain a full outer shell. Since electron transfer can occur between Na / K and O, an ionic bond / electrostatic force forms. However, Na and K cannot react with each other since they each lose one valence electron, i.e. electron transfer cannot occur.

(b)	<table><tr><th>Unlabelled solution</th><th>Observation (if any) with red litmus paper</th><th>Observation (if any) with potassium carbonate</th></tr><tr><td>Nitric Acid</td><td>Stays red</td><td>Fizzes / heat / reacts</td></tr><tr><td>Sodium Chloride</td><td>Stay red</td><td>No reaction</td></tr><tr><td>Sodium hydrogen carbonate</td><td>Turns blue</td><td>No reaction</td></tr></table> Only the sodium hydrogen carbonate will turn the litmus blue, since it is a base. Add potassium carbonate to the remaining two solutions. Since nitric acid is an acid, it will undergo a neutralisation reaction with the basic potassium carbonate to produce bubbles / fizzing of carbon dioxide, according to the equation below: $K_2CO_3 + 2HNO_3 \rightarrow 2KNO_3 + H_2O + CO_2$ No changes will be observed with the sodium chloride since it is a neutral salt.	• ONE row of table correct. • ONE column of table correct. • Explains one observation. • 4 / 5 symbols correct in equation.	• Table complete with one observation explained. • Correct formulae for symbol equation, but not balanced.	• Explanations to correctly identify ALL solutions, with observations linked to properties (i.e. complete table and both observations explained). • Correctly balanced symbol equation.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	Any ONE point.	Any TWO points.	Any THREE points.	Any FOUR points.	TWO points.	THREE points.	TWO points.	ALL THREE points.

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)(i)	Each silver (Ag) atom loses one electron to form the Ag^+ ion; however, each oxygen atom requires two electrons to fill its outer shell. Therefore, two Ag atoms react for every O atom, i.e. two Ag atoms lose 2 electrons and one O atom gains 2 electrons. The two Ag^+ ions have a total charge of +2 to balance the –2 total charge of the O^{2-} ion, i.e. an ionic compound has no overall charge.	• States that overall an ionic compound has no charge since the charges must cancel out / balance. • States silver needs to lose 1 electron and oxygen needs to gain 2 electrons (to form ionic bond)	• Explains that since the oxygen atom needs to gain two electrons, one oxygen atom will react with two silver atoms, as each silver atom will lose one electron • Explains that because the silver ion has a charge of +1 and the oxide ion has a charge of –2, the ratio of silver ions to oxide ions is 2:1 in order to have a neutrally charged compound overall	• Full justification of the formula Ag_2O. Including electron transfer and that when neutrally charged, two Ag^+ ions have a total charge of +2 and one O^{2-} ion has a total charge of –2 which equals zero / no overall charge as they have cancelled each other out.
(ii)	Silver oxide + hydrochloric acid → silver chloride + water $Ag_2O + 2HCl \rightarrow 2AgCl + H_2O$	• Correct word equation	• Correct formulae for symbol equation, but not balanced.	• Correctly balanced symbol equation.
(b)	The HCl is initially red since $[H^+]$ is much greater than $[OH^-]$; the pH is 1–2. As NaOH is added, the OH^- start to neutralise some of the H^+. As the pH increases to 3–6, the solution turns orange / yellow and $[H^+] > [OH^-]$. Once enough NaOH has been added such that $[OH^-] = [H^+]$, the UI turns green since **all** the H^+ have been **neutralised** by the added OH^- ions to form water, and the pH equals 7. $H^+ + OH^- \rightarrow H_2O$ As more NaOH is added, the pH increases to pH 8–11 since $[OH^-] > [H^+]$, so the UI turns blue. As yet more NaOH is added, the pH increases to 12–14 since $[OH^-]$ becomes much greater than $[H^+]$, so UI turns purple. [Information may be given in a table.]	• Describes two correct colours other than red in correct order as NaOH is added • Links two pH values to correct colour. • Describes the relative concentration of H^+ and OH^- for at least 1 point. • Describes neutralisation - identifies that H^+ ions are neutralised as OH^- ions are added. OR $H^+ = OH^-$ OR Acid and base cancel out and pH is 7.	• Explains that before any NaOH is added, the H^+ ions are in excess, and as more NaOH is added the concentration of H^+ ions decreases until OH^- ions are in excess. OR Explains that once a sufficient number of OH^- ions have been added to neutralise all the H^+ ions to form water / neutral substances, the pH equals 7. • Links all UI colours (red, yellow / orange, green, blue / purple,) to EITHER correct pH values OR relative concentrations of ions present.	• Fully explains and links the colour changes to the changing pH, relative concentration of H^+ ions and OH^- ions present, and neutralisation reaction occurring.

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

Cut Scores

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