

Assessment Schedule – 2019

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Nitric acid + calcium carbonate → calcium nitrate + water + carbon dioxide $2\text{HNO}_3 + \text{CaCO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$	<ul style="list-style-type: none"> Correct word equation. OR ALL product formulae correct.	<ul style="list-style-type: none"> Correct formulae for symbol equation, but not balanced. 	<ul style="list-style-type: none"> Correctly balanced symbol equation.
(b)	When more concentrated acid is used, there are more acid particles / H^+ ions / nitric acid particles 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.	<ul style="list-style-type: none"> Definition of rate of reaction eg. the number of particle collisions per second. OR Definition of collision theory eg. particles collide / hit / at the correct orientation with enough energy.	<ul style="list-style-type: none"> Explains that by increasing the concentration of the acid / the tube with the higher concentration there are more acid particles present to collide (successfully) so the reaction rate is faster. 	<ul style="list-style-type: none"> 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, and hence there will be more frequent collisions / collisions per second / collisions per unit time, causing the faster reaction rate. Needs to link ideas of increased conc. to more particles for more successful collision per second/frequency of collisions resulting in increased / faster the rate of reaction.
(c)	As the temperature of the nitric acid increases, the particles move faster and have more (kinetic) energy. There are more collisions per second between the acid and the carbonate 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 will occur faster.	<ul style="list-style-type: none"> Increasing temperature causes more (frequent) collisions OR particles have more energy/move faster OR converse. Reaction occurs when particles collide successfully. More (successful) collisions per second cause a faster rate of reaction (or from above). 	<ul style="list-style-type: none"> Explains acid particles at the higher temperature will have more energy so there will be more successful collisions. Explains 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 calcium carbonate 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.

N0	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 points.	THREE Excellence points.

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Ca: 2,8,8,2 Cl: 2,8,7	<ul style="list-style-type: none"> States the electronic arrangement of one atom. 		
(b)(i) (ii)	<p>Both ions have the electron arrangement 2,8,8</p> <p>Ca²⁺ because it has 20 + protons (+ charges) and only 18 -electrons (- charges). It has only 18 electrons, as its electron arrangement as an atom was 2,8,8,2, and when it forms an ion, it loses two electrons to form an arrangement of 2,8,8 to have a full outer shell, which is more stable.</p> <p>Cl⁻ because it has 17+ protons (+ charges) and 18 - electrons (- charges). It has 18 electrons, as its electron arrangement as an atom was 2,8,7 and when it forms an ion, it gains one electron to form an arrangement of 2,8,8 to have a full outer shell, which is more stable.</p>	<ul style="list-style-type: none"> States the electronic arrangement of the ions. Defines an ion E.g. An atom that has gained or lost an electron to become stable / have a full outer shell States that Ca atom loses two electrons. OR Cl atom gains one electron. (**Ca may be in (c). Explains the charge on one ion in terms of electron arrangement And atomic structure (protons and electrons). 	<ul style="list-style-type: none"> Explains since Ca needs to lose 2 electrons, and Cl only needs to gain one electron for each to have a full outer shells / be stable. Explains the charge on the ions in terms of the balance of + protons and - electrons in the ion. For M must show they know charges on protons and electrons. 	<p>All electron arrangements plus Ca has 20 +protons and 20 - electrons. It has two electrons in its valance shell so needs to lose them to get a have a full outer shell to become stable. It now has 2 less e⁻ than p⁺ and becomes Ca²⁺. Cl has 17p⁺ and 17e-electrons with one e⁻ in its valance shell. It needs to gain 1 e⁻ to get a full outer shell and be stable. It now has 1 more e⁻ than p⁺ so is Cl⁻.</p>
(c)	<p>Calcium loses 2 electrons to form Ca²⁺ ending up with a charge of +2. Chlorine will gain only one electron to become Cl⁻ and have a charge of -1. As Ca reacts, it loses the 2 electrons in its outer shell; one to each Cl atom to fill their outer shells. In order to have a neutral compound, one Calcium ion is needed to cancel out the charge on two chloride ions with a combined charge of -2.</p>	<ul style="list-style-type: none"> States that overall an ionic compound has no charge so charges must cancel out. OR +2 charge on calcium ion cancels / balances the two -1 charges on chloride ion. 	<ul style="list-style-type: none"> Explains that since the Calcium needs to lose 2 electrons, one Ca will react with 2 Cl as the Cl only need 1 electron each to have full shells / to be stable. Explains that because the calcium ion has a charge of +2 and the chloride ion has a charge of -1, the ratio of calcium ions to chloride ions is 1:2, so forming a neutral compound overall. 	<ul style="list-style-type: none"> The Ca atom needs to lose 2 electrons but Cl only need to gain one so that each will have a full outer shell and be stable. Ca ion has a charge of +2 while Cl has -1 so there needs to be two Cl's so that they can accept one electron each from Ca / Ca needs two Cl's so it can give one electron to each. The charges then cancel each other out to make a compound with a neutral / no / zero charge.

A

N0	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														
THREE (a)(i)	<table border="1"> <thead> <tr> <th rowspan="2">Unlabelled solution</th> <th colspan="2">Observation (if any)</th> </tr> <tr> <th>with red litmus paper</th> <th>Baking Soda NaHCO₃</th> </tr> </thead> <tbody> <tr> <td>hydrochloric acid, HCl</td> <td>stays red / no change</td> <td>fizzes / bubbles / heat / reacts</td> </tr> <tr> <td>sodium chloride, NaCl</td> <td>stays red</td> <td>no reaction</td> </tr> <tr> <td>sodium hydroxide, NaOH</td> <td>turns blue</td> <td>no reaction</td> </tr> </tbody> </table>	Unlabelled solution	Observation (if any)		with red litmus paper	Baking Soda NaHCO ₃	hydrochloric acid, HCl	stays red / no change	fizzes / bubbles / heat / reacts	sodium chloride, NaCl	stays red	no reaction	sodium hydroxide, NaOH	turns blue	no reaction	<ul style="list-style-type: none"> ONE row of table correct. OR ONE column of table correct. Gives a reason for ONE observation. 	<ul style="list-style-type: none"> Table correctly completed with ONE observation explained. OR TWO observations explained. 	<ul style="list-style-type: none"> Explanations to correctly identify ALL solutions with observations linked to properties.
Unlabelled solution	Observation (if any)																	
	with red litmus paper	Baking Soda NaHCO ₃																
hydrochloric acid, HCl	stays red / no change	fizzes / bubbles / heat / reacts																
sodium chloride, NaCl	stays red	no reaction																
sodium hydroxide, NaOH	turns blue	no reaction																
(ii)	<p>Only the sodium hydroxide will turn the litmus blue, since it is a base. Add baking soda to the remaining two solutions. Since hydrochloric acid is an acid, it will undergo a (neutralisation) reaction with the baking soda to produce bubbles / fizzing / heat of carbon dioxide. No changes will be observed with the sodium chloride since it is a neutral salt.</p>																	
(b)(i) (ii) (iii)	<p>Acid-base reaction or neutralisation.</p> <p>Sulfuric acid + copper carbonate → copper sulfate + water + carbon dioxide $H_2SO_4 + CuCO_3 \rightarrow CuSO_4 + H_2O + CO_2$</p> <p>Add the solid copper carbonate to the sulfuric acid. The reaction is completed when bubbles (of carbon dioxide) are no longer produced, as the reactant (sulfuric acid) has been used up and neutralised. Alternatively, the reaction could be followed by measuring the pH using universal indicator or probe, and the reaction would be complete at pH 7.</p> <p>Leave the resultant solution in a warm place / heat until water has evaporated to leave copper sulfate behind.</p>	<ul style="list-style-type: none"> Acid-base or neutralisation reaction. Correct word equation OR Reactant formulae correct. OR Product formulae correct. Observation that bubbles / fizzing would stop. OR pH of 7 reached. States heat OR evaporate the mixture. 	<ul style="list-style-type: none"> Correct formulae for symbol equation. Explains why the reaction would be completed when no more bubbles are produced. OR Why the reaction would be completed at pH 7. Explains how to get a solid / crystal. 	<ul style="list-style-type: none"> m2 plus: Fully explains how copper sulfate can be made from copper carbonate, CuCO₃, and sulfuric acid, H₂SO₄ including when the reaction has been completed. Needs evaporation (in some way) of H₂O (leaving behind copper sulphate). 														

N0	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.

Cut Scores

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