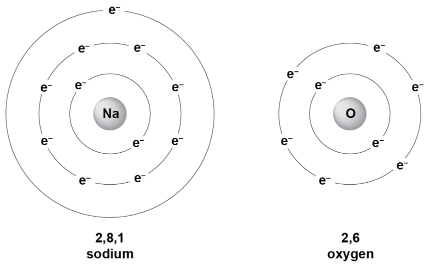
Assessment Schedule – 2020

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i) (ii) (iii)	 …… Both ions..2, 8 Na needs to lose an electron to have a full outer shell and become stable. Na forms a Na^+ ion, which has a charge of +1, as it now has 10 negative electrons and 11 positive protons O needs to gain two electrons to have a full outer shell and become stable. O gains 2 electrons to form O^{2-} ion, which has a charge of –2, as it now has 10 negative electrons and 8 positive protons. Therefore, Na^+ and O^{2-} ions now both have the same electron arrangement of 2,8.	A1 Correctly gives the electron arrangement of both atoms in (i) OR both ions in (ii) *Accept written e arrangements.* A2 States that full outer shells are stable. *Accept 'full valence shells' as stable for A* A3 Defines ion, e.g. an ion is an atom that gains or loses electrons to get a full outer shell. A4 Correct number of protons for both A5 Correct charge for both / number of electrons lost or gained	M1 Explains that sodium and oxide ions have the same electron arrangement (2,8) as sodium has lost 1 electron to get a full outer shell / become stable, and oxygen has gained two electrons to get a full outer shell / to become stable M2 Explain how two ions have different charge: Na^+ now has one more proton than electron & O^{2-}.has two more electrons than protons	E1 Explains why the two ions have the same electronic arrangement: achieve stable, full outer shells by Na losing one electron, O gaining two electrons and therefore having the same electron arrangement of 2,8 AND Explains why two ions have the same arrangement, but a different charge: sodium ion is Na^+ as it now has one more positive proton than negative electron, and oxide ion is O^{2-} as it now has two more negative electrons than positive protons. *Must show they KNOW charges of P+ and e– somewhere.*

<table>
<tr><td>(b)(i)

(ii)</td><td>

Unlabelled solution	Observation with red litmus paper	Observation (if any) with sulfuric acid (H_2SO_4)
sodium hydrogen carbonate ($NaHCO_3$)	Turns blue	Fizzes / bubbles
sodium hydroxide ($NaOH$)	Turns blue	no visible reaction accept a dash (not blank). heat produced

Both sodium hydrogen carbonate and sodium hydroxide are bases, so will turn the red litmus blue.

Add sulfuric acid to the remaining two solutions. Sodium hydrogen carbonate is a hydrogen carbonate / a base / releases OH^-; it will undergo a neutralisation reaction with the acid to produce carbon dioxide which makes bubbles / fizzing of.

Sodium hydroxide is a base / releases OH^-; will undergo a neutralisation reaction but will not produce bubbles / fizzing carbon dioxide./.no change observed.</td><td>A6 ONE row of table correct OR ONE column of table correct.
Obs must be able to be seen / felt – can't just say CO_2 or gas made as not observable,
A7 Explains one observation.
Can't just repeat what is in table but "red litmus turns blue in a base" ok .</td><td>M3 Table complete with ONE observation explained.
Accept if observation given in text when table gives 'products' not observation.</td><td>E2 Explanations to correctly identify solutions, with observations linked to properties (i.e. complete table and ALL observations explained)..
Student may explain that that HCO_3 OR NaOH are both bases so will both.turn red litmus blue in one sentence – is fine as long as they explain WHY one.produces bubbles / fizzes and the other doesn't. Must link 'bubbles' to CO_2.</td></tr>
<tr><td>(iii)</td><td>Sodium hydrogen carbonate + sulfuric acid
→ sodium sulfate + water + carbon dioxide
$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2$..
Sodium hydroxide + sulfuric acid
→ sodium sulfate + water
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$</td><td>A8 ONE correct word equation.
Check carefully for the incorrect 'sulphide'</td><td>M4 Correct formulae for ONE symbol equation, but not balanced.</td><td>E3 ONE correctly balanced symbol equation
Be careful to watch for CO_3 in place of CO_2 for the hydrogen carbonate!</td></tr>
</table>

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 points	THREE Excellence points.

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	For a reaction to occur, reacting particles must collide. The Oamaru stone powder has more surface area for the HCl 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.	A1 Describes collision theory. A2 There are more reactant particles at the start so there will be more collisions / faster rate of reaction A3 The powder has a higher rate of reaction / more collisions. OR Converse. A4 The powder has more surface area (OR Converse).	M1 Explains that the powdered Oamaru stone has a greater surface area, and so more surface area for the HCl particles to collide with / available for a reaction. *Must talk about HCl / acid / reactant particles* OR At the start of both reactions there are the most reactant particles available for a reaction M2 Explains that the more frequent collisions increase the rate of reaction / production of carbon dioxide OR the loss of mass of the flask and its contents.	E1 Explains that the Oamaru powder 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 $CaCO_3$ to react with the HCl. This produced the same mass of carbon dioxide (product), and the same mass loss from the flask to the air. *Accept amount for mass and don't penalise if candidate doesn't refer the NAMES of reactants.* *NOTE: Basically if have all 3 Merits, they have the E1.*
(b)	Each Oamaru stone sample contained the same mass of reacting calcium carbonate to react with the HCl. This produced the same mass of carbon dioxide / products, and the same mass loss from the flask to the air.	A5 States that the same mass of Oamaru stone / $CaCO_3$ was in each sample. *Accept same 'amount' / both 5g etc.*	M3 Explains that the samples contained the same mass / amount of reactant particles of $CaCO_3$ to react with the HCl. This produced the same mass of carbon dioxide / products.	
(c)	Calcium forms an ion with a charge of +2. It requires two negative charges to form a neutral compound. The chloride ion has a charge of –1, so two chloride ions, with a combined charge of –2 are required to cancel out the charge on the calcium ion. The carbonate ion has a charge of –2, so only one carbonate ion is required to cancel out the charge on the calcium ion.	A6 States that overall an ionic compound has no charge A7 States that the +2 charge on the calcium ion cancels out / balances the two –1 charges on the chloride ions. A8 States that the +2 charge on the calcium ion cancels out / balances the –2 charge on the carbonate ion.	M4 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. M5 Explains that because the calcium ion has a charge of +2 and the carbonate ion has a charge of –2, the ratio of calcium ions to carbonate ions is 1:1. OR as Alternative of M4 or M5 (one M point only) Explains in terms of electron transfer for one of the compounds.	E2 Fully explains the ratio of ions in both calcium chloride AND calcium carbonate in terms of the balance of positive and negative charges in the two compounds AND must include the compounds have no charge / zero charge are neutrally charged *Accept a good explanation using + protons.and – electrons.and electron transfer if it is clear that the + and – charges must cancel out.* *Do NOT just accept so compounds are balanced. Idea of electron transfer not needed.*

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
THREE (a)(i) (ii)	Beaker A. Beaker A has a higher [H^+] compared to [OH^-] than Beaker B, and therefore has a lower pH./.is more acidic than Beaker B. UI is orange at a pH of 3–4, whereas UI is red for an acid with a lower pH of 1–2. *NOTE: Canidates can use Beaker A or Red solution and Beaker 2 or Orange solution when referring to (a).*	A1 Beaker A in (i) or states Beaker A more acidic in (ii). *Not 'stronger'.* A2 The solutions are different colours because they have different pH / acidity / concentrations of H^+. *Don't 'double dip' A1 and A2 for 'A more acidic than B', ONE A POINT only.* A3 The lower the pH, the more H^+ ions or vice versa (or less OH^-).	M1 Explains that Beaker A is red because it has a pH of 1–2, compared to Beaker B which is orange because has a pH of 3–4. *Accept 1–2 or just 1 or 2 for Beaker A and 3–4 or just 3 or 4.for B or any reasonable range but NO overlaps in pH between the two beakers. No pH6 (as this is yellow).* M2 Explains that both solutions have more / excess hydrogen ions.	E1 Beaker A with a pH of 1–2 has a greater excess of / more.hydrogen ions (compared to hydroxide ions) compared to Beaker B of pH 3–4, and hence Beaker A is more acidic. *Note: clever canidates may say that in the red has a huge excess of H+ and.orange beaker still an excess of H+ but less than in the red beaker because OH^- have reacted with / neutralized them to form water – which is a much better answer than comparing.number of H^+ to OH^- by saying more H^+ than OH^-.*
(b)	Neutralisation or acid base.	A4 Neutralisation or acid base.		
(c)	As the temperature of the mixture increases, the particles move faster and have more energy. There are more collisions per second between the reacting particles due to faster 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.	A5 Increasing temperature causes more (frequent) collisions OR Converse. A6 Increasing temperature means particles have more energy / move faster OR converse. A7 Reaction occurs when particles collide successfully OR more (successful) collisions per second cause a faster rate of reaction (or from above). *Accept description for collison theory for A7.*	M3 Explains that the higher temperature causes the particles to move faster therefore there will be more frequent collisions / more collisions per second / more collisions per unit of time *Accept 'higher chance of collisions' plus good answer for M but not for E* M4 Acid particles at higher temperatures will have more energy / force, resulting in more successful collisions.	E2 Fully explains that increased temperature leads to faster particles colliding more often. AND More of these collisions have enough energy / force to cause successful collisions / reactions. Therefore there will be more successful collisions per second / more successful collisions will happen more frequently so rate of reaction will be faster *Needs the two ideas that more heat makes particles move FASTER so hit / collide more FREQUENTLY / more often / and THAT they hit / collide with enough ENERGY / force to make those collisions SUCCESSFUL so a reaction occurs.*

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.

Cut scores

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