Assessment Schedule – 2013

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

Evidence Statement

<table>
<tr><th>Question</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr>
<td>ONE
(a)

(b)</td>
<td>
<table>
<tr><th></th><th>Atomic number</th><th>Number of protons</th><th>Number of electrons</th><th>Electron arrangement</th></tr>
<tr><td>F^-</td><td>9</td><td>9</td><td>10</td><td>2,8</td></tr>
<tr><td>Ne</td><td>10</td><td>10</td><td>10</td><td>2,8</td></tr>
<tr><td>Mg^{2+}</td><td>12</td><td>12</td><td>10</td><td>2,8</td></tr>
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The difference between an ion and an atom is that an atom has a neutral charge as it has not gained or lost electrons and therefore has the same number of protons (+) and electrons (–) whereas an ion has a charge as the atom it was formed from has either gained or lost electrons to form a full outer shell and therefore has a different number of protons (+) from the number of electrons (–).
Explanation of charges
Fluorine has 9 protons and electron arrangement of 2,7.
Neon has 10 protons and an electron arrangement of 2,8.
Magnesium has 12 protons and an electron arrangement of 2,8,2.
Fluorine gains one electron to have a full outer shell. This is because it is in group 17 and has 7 valence electrons. For fluorine ion, the electron arrangement is 2,8.
Fluorine has a charge of –1 as it now has 10 electrons (negative charges) and nine protons (positive charges).
Neon has no charge as it has the same number of protons and electrons, as it has not gained or lost electrons, as it has an electron arrangement of 2,8 because it is in group 18 of the periodic table and its valence shell is complete.
Magnesium has 12 protons and electron arrangement of 2,8,2.
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• Correctly gives the electron arrangements of all three.
• Shows (may be diagram) that magnesium loses two electrons and that fluorine gains one while neon does not gain or lose any electrons.
• Correctly states number of electrons for all three species.
• Explains the charge on one ion or atom in terms of electron arrangement AND atomic structure.
• States that an atom has no charge as it has not gained or lost electrons.
OR
an ion has a charge as it has either gained or lost electrons.
• State the group that all three atoms are in (F 17, Ne 18, Mg 2).
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• Explains that all three need to have the same number of electrons in order to have full outer (valence) shells. This is because fluorine has gained one electron, magnesium has lost two electrons, and neon has not lost or gained electrons.
• Explains when neon loses no electrons, fluorine gains one and magnesium loses two, that all 3 then have the same electron arrangement (2,8).
• Explains the difference between an ion and an atom in terms of an ion having different numbers of protons and electrons whereas an atom has the same number of protons and electrons.
• Explains the charge on two species in terms of protons and electrons.
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• Explains why all three have the same electron arrangement: achieve full outer shells by either losing two electrons, gaining one electron or not losing or gaining any electrons and the nearest stable electron arrangement is 2,8 and their position on the periodic table is stated.
• Explains why the three have different charges:
- F^- has a negative one charge as it has gained an electron to achieve a full outer shell but still has 9 protons and therefore has one more electron (negative charge) than protons (positive charge).
- Mg^{2+} has a positive two charge as it has lost two electrons to achieve a full outer shell but still has 12 protons and therefore has two less electrons (negative charge) than protons (positive charge).
- Neon has no charge as it does not need to gain or lose electrons to achieve a full outer shell and therefore has 10 protons and 10 electrons.
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	Magnesium has two electrons in its outer shell as it is in group 2 of the periodic table, which it loses, so its outer shell is full (2,8) and it has a charge of +2, as it still has 12 protons (positive charges) and now has only 10 electrons (negative charges). All three have the same electron arrangement as they have gained one electron, lost two electrons or have neither gained or lost electrons. The electron arrangement is 2,8 as this is the nearest possible stable electron arrangement for all three.								
	Not achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
Q1	NØ = no response or no relevant evidence	N1 = 1 point	N2 = 2 points	A3 = 3 points	A4 = 4 points	M5 = 2 points	M6 = 3 points	E7 = 1 point	E8 = 2 points

Question	Evidence	Achievement	Merit	Excellence
TWO (a) (b)	Sulfuric acid + potassium hydroxide → potassium sulfate + water $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ As the KOH is added, the H_2SO_4 is being neutralised until water is formed, then after that the solution becomes more basic. When no KOH has been added, the solution is red and has a pH of 1–2 and there is an excess of H^+ ions. As the solution becomes orange-yellow, the pH becomes 4–6. There is still an excess of H^+ ions but not as big an excess as when the pH was lower. When 10 ml has been added and the solution is green, the pH is 7, which is neutral. At this point, the number of H^+ and OH^- ions is equal and they cancel each other out to form water. After 15 mL has been added and the solution is blue, the pH is 9–12 and there is now an excess of OH^- ions. When 20 mL have been added and the solution is purple, the pH is 13–14 and there is now a greater excess of OH^- ions than when the solution was blue. Litmus paper is useful to tell us if a solution is acidic, basic or neutral. (When blue litmus turns red and red litmus stays red, this tells us the solution is acidic. When both blue and red litmus papers stay the same, this tells us the solution is neutral. When red turns blue, this tells the solution is basic.) UI however tells us more information and tells us how acidic, basic a solution is or if it is neutral. Litmus is limited as it only tells us if it is acid, basic, or neutral whereas UI tells us how acidic or basic it is. You don't have to keep dipping / adding UI like you do litmus paper. (UI may be answered for solution or paper.)	• Links two pH values to colour other than pH = 7. • States when colour is green and the pH is 7 the solution is neutral. • States that the acid / H_2SO_4 provides hydrogen ions. OR States that the base / KOH provides hydroxide ions. • Correct word equation OR Correct symbol equation with one mistake in ionic formula. • Red litmus turns blue in base OR blue litmus turns red in acid. • Both pieces of Litmus stay the same colour in water / neutral. • Litmus has two colours to start with, but UI has only one. • Litmus you need 2 bits but UI you only need to add one thing. • UI tells you more information about the pH. (How acidic / basic something is.)	• Explains that H^+ and OH^- combine to form water (or neutralise each other). • Correct symbol equation but not balanced. • Explains that before any KOH is added to beaker one that H^+ are in excess, and as more KOH is added the concentration of OH^- increases until OH^- ions are in excess. • Explains that litmus tells us only if a solution is acidic, basic or whereas UI tells us not only if a solution is neutral, but also tells us how acidic or basic it is. OR explains how litmus works, ie both stay the same equals neutral, blue changing to red acidic and red changing to blue basic.	• Correctly balanced symbol equation. • Links the colour change to the pH by relating it to the ions that are present in beaker when it is acidic (red), neutral (green), and basic (purple). • Compares the amount of excess of H^+ ions at 0 (red) and 5 mL (yellow). OR Compares the amount of excess OH^- ions at 15 (blue) and 20 mL(purple). AND links these to the pH and colour of solution.

	Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q2	NØ = no response or no relevant evidence	N1 = 1 point	N2 = 2 point	A3 = 3 points	A4 = 4 points	M5 = 2 points	M6 =3 points	E7 = 2 points	E8 = 3 points

Question	Evidence	Achievement	Merit	Excellence
THREE (a) (b) (c)	The factor being investigated is surface area of the calcium carbonate / marble chips. In section A of the graph the rate is fastest as there are more collisions between the HCl and $CaCO_3$. This is because at the start of the reaction there are more particles available for collision. In section B the rate of reaction is slowing down as the number of particles available for collision is becoming fewer as some of the HCl and $CaCO_3$ have already collided and have been used up, therefore fewer particles and therefore fewer collisions. In part C the reaction has stopped, as all of the reactants (or one of them) have reacted, and therefore there are no particles present that can collide and react. The rate of Experiment 1 is faster as the slope in section A of the graph is steeper than in Experiment 2. It is faster because when smaller chips are used, the surface area of the chips is greater. Because there is more surface area, there is more surface for the HCl particles to collide. Because there are more collisions occurring more frequently, the rate is faster.	• Identifies surface area as the factor being investigated. • States that at the start of the reaction there is the highest number of reactants. OR In section B there are less reactants, but not as many in section A, so the reaction rate is less. OR At the end one or both of the reactants has been used up. • States the reaction is fastest at the start, then slows down • In section C the reaction has stopped. • When smaller chips are used there is more surface area OR more collisions.	• Two of the three ideas below linked. - It is faster because when smaller chips are used, the surface area of the chips is greater. - Because there is more surface area, there is more surface for the HCl particles to collide. - Because of this, there are more collisions occurring more frequently and therefore the rate is faster. • Explains why surface area is the factor being investigated because the size of the chips is changed AND explains two of the sections of the graph. • The rate of Experiment 1 is faster as the slope of the graph is steeper than Experiment 2.	• The rate of Experiment 1 is faster as the slope of the graph is steeper than Experiment 2. It is faster because when smaller chips are used, the surface area of the chips is greater. Because there is more surface area, there is more surface for the HCl particles to collide. Because there are more collisions occurring more frequently, therefore the rate is faster. • Compares the rate in all three sections of the graph with reasons that justify this.

	Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q3	NØ = no response or no relevant evidence.	N1= 1 point	N2 = 2 point	A3 =3 points	A4 = 4 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points

Question	Evidence	Achievement	Merit	Excellence
FOUR (a) (b) (c) (d)	The purpose of Experiment 1 is to make the neutral salt, calcium chloride. UI is used to check the pH of the solution. Calcium hydroxide is added so that it reacts with HCl to form calcium chloride. It is added until the solution is green so that the solution formed is neutral. The contents are put into an evaporating dish so that the water can evaporate to leave the salt calcium chloride. It is left for a few days to ensure that all the water has evaporated as this process takes time. *Experiment 2* hydrochloric acid + sodium carbonate → sodium chloride + water + carbon dioxide $2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$ Fizzing would be observed. The fizzing observed is due to carbon dioxide gas being released, and therefore because the carbon dioxide gas is leaving the beaker, there is less mass remaining in the beaker and therefore the balance measures less weight.	• To make calcium chloride or a salt. • UI used to monitor pH. • To make something neutral / to neutralise the acid. • The solution is put in an evaporating dish to get rid of the water. • Correct word equation. OR Correct symbol equation with one mistake. • Fizzing would be observed. • Carbon dioxide is being produced.	• Explains why UI is used, ie so that the student knows when to stop adding calcium hydroxide, as the solution is neutral. • Explains that the dish is left for a few days, so that the water can evaporate, leaving the neutral salt calcium chloride. • Correct equation but not balanced. • Fizzing because carbonate reacts with acid to make carbon dioxide gas. • Carbon dioxide is leaving the beaker.	• Explains fully the purpose of each step, ie UI is used to determine the pH and a neutral salt is required so the student knows when to stop adding calcium hydroxide when the solution becomes green, when it is green it is then left in an evaporating dish so that the water can evaporate, leaving the neutral salt calcium chloride. • Correctly balanced equation. • Carbon dioxide is leaving the beaker therefore the mass remaining in the beaker is less.

	Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
Q4	NØ = no response or no relevant evidence	N1 = 1	N2 = 2 points	A3 = 3 points	A4 = 4 points	M5 = 2 points	M6 = 3 points	E7 = 2 points	E8 = 3 points

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 9	10 – 17	18 – 26	27 – 32