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NZQA

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Level 1 Science, 2018

90944 Demonstrate understanding of aspects of acids and bases

9.30 a.m. Thursday 15 November 2018
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of acids and bases.	Demonstrate in-depth understanding of aspects of acids and bases.	Demonstrate comprehensive understanding of aspects of acids and bases.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Pull out Resource Booklet 90944R from the centre of this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 17

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QUESTION ONE

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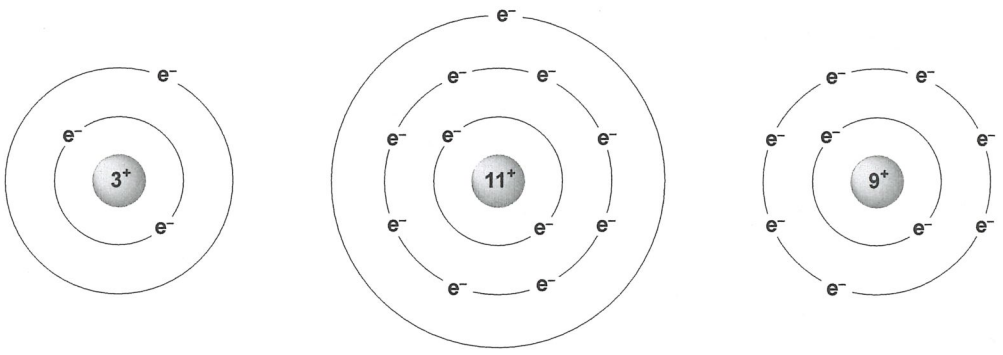
The diagrams show models of three different atoms:



Lithium Sodium Fluorine

Use the diagrams to answer parts (a), (b), and (c).

(a) Why are lithium and sodium in the same group (column) of the Periodic Table, but in different periods (rows)?

They're in the same group (group One) as they both have one electron in their valence shells but they're in different periods (Sodium: period 3 Lithium: period 2) as they have different number of shells (Sodium: three shells Lithium: two shells).

(b) Sodium and fluorine form ions that both have the same electron arrangement.

How can sodium and fluoride ions have the same electron arrangement but different charges?

In your answer you should refer to the number of protons, charge, and electron arrangement of the two atoms and ions.

A sodium ion has eleven protons which one more than the n.o. electrons (10) because the number of protons is not affected by ionization, giving a sodium ion a charge of +1 as protons have a positive charge. To become ionized and become stable it has to lose one electron, giving it the electron arrangement: 2,8.

Fluorine has to gain an electron which has a negative charge to ionize and become stable giving it the same electron arrangement as a Sodium ion (2,8) but different charge as there is one electron more than protons (+ve charge) giving it an overall charge of -1.

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(c) Magnesium fluoride has the formula MgF_2.

Explain how the ratio of ions in the formula is linked to the charge on the ions.

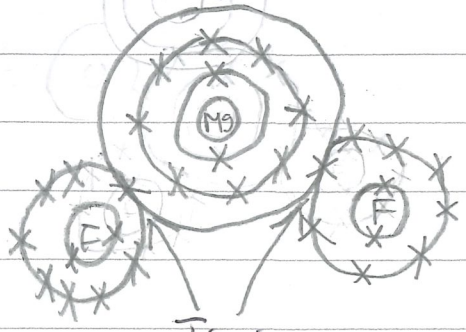
In your answer you should include the number of electrons gained or lost by each atom as it forms the ionic compound.

A diagram may assist your answer.

Magnesium (Mg) needs to lose two electrons in its valence shell to become stable whereas Fluorine (F) needs and can only take one electron in its valence shell to become stable. So there needs to be two fluorine atoms for there to be an ionic bond with magnesium so the ratio is 1 Mg : 2 F (1:2), as the two fluorine gain an electron each and become stable and the magnesium has lost to electrons and become stable.

Magnesium Fluoride:

Key: X-electron



Ionic bond

M5

QUESTION TWO

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Solutions of potassium hydroxide, KOH, and sulfuric acid, H_2SO_4, are added together in a beaker.

(a) Name the type of reaction occurring.

neutralization

(b) Write the word equation and the balanced symbol equation for this reaction.

Word equation

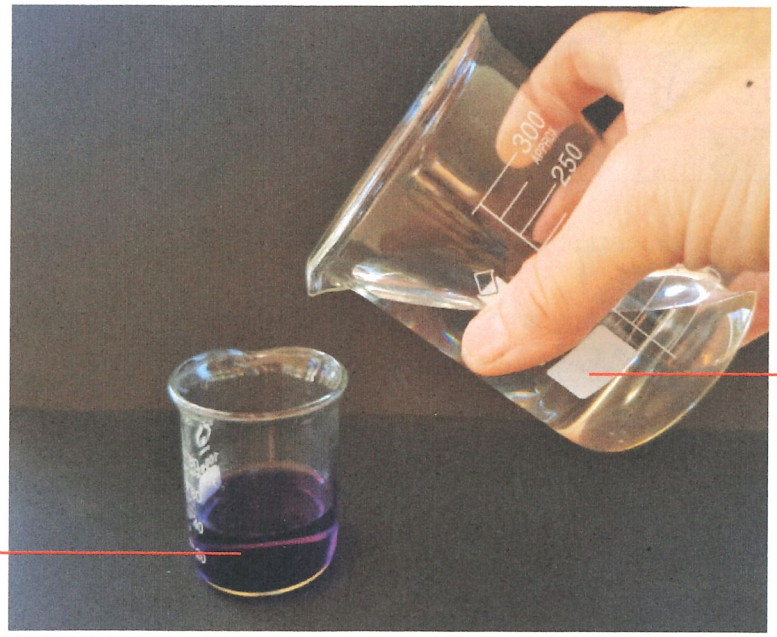
Potassium Hydroxide + Sulfuric Acid → Potassium Sulfate + Water

Balanced symbol equation

$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

(c) A solution of potassium hydroxide is placed in a beaker. Universal indicator is added to it. The solution is purple, as shown in the diagram below.

Sulfuric acid is slowly added to the beaker until **no more colour changes are seen**.



Explain in detail what happens to the **colour** of the solution while the sulfuric acid is being added to the potassium hydroxide.

Link your answer to the concentration of **ions** and the changing **pH** of the solution.

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When sulfuric acid is first added, the solution is still basic with a pH of ~~11-12~~ 12-11 which is a lighter shade of purple and there is still a large excess of OH^- (hydroxide) ions. When more acid is added the pH becomes 10-9 which is ~~dark~~ blue so there is a slight excess of OH^- ions. When more is added the pH becomes 8 which is a dark green and there is a very small difference between OH^- and H^+ (hydrogen) ions, with OH^- still in excess. When a little more is added the pH becomes 7 which is a light green meaning there is an even n.o. OH^- and H^+ ions (neutral). When more acid is added the solution becomes acidic with a pH of colour is yellow 6-5 so there is a small difference between n.o. OH^- and H^+ ions, with H^+ ion in excess. When more acid is added, the pH becomes 4-3 which is orange so there is a slight excess of H^+ ions. When more is added the pH becomes 2-1 which is red and there is a large excess of H^+ ions. If more is added the pH becomes 0 which is dark red. At this point, there is very little to no OH^- ions present in the solution making it purely acidic.

M6

QUESTION THREE

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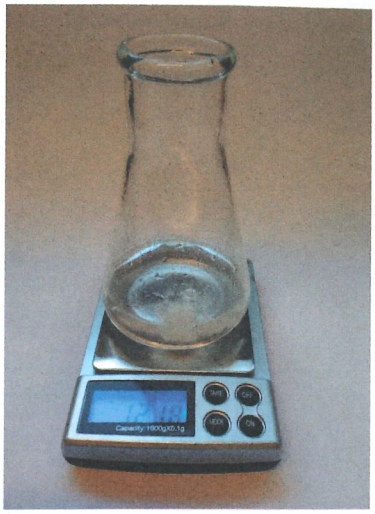
Some magnesium carbonate powder is added to dilute nitric acid in an open conical flask. The flask is on an electronic balance, as shown in the illustration.



(a) Write the word equation AND the balanced symbol equation for the reaction between the nitric acid and magnesium carbonate.

Word equation

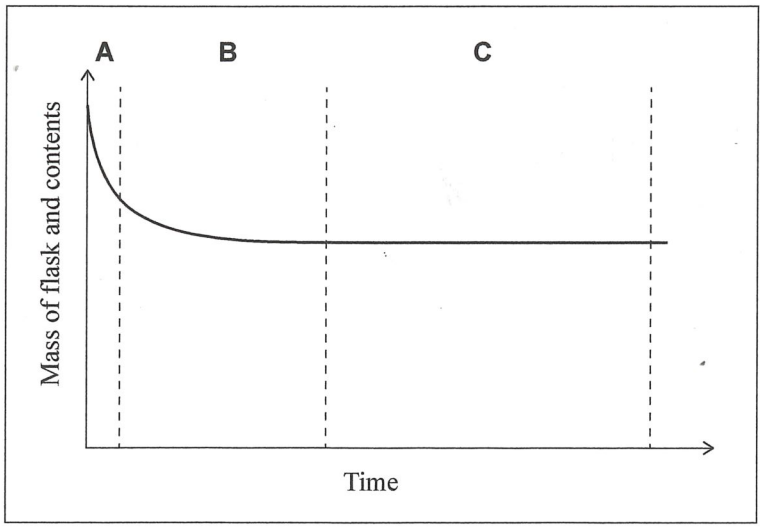
Magnesium Carbonate + Nitric Acid → Magnesium Nitrate + Carbon Dioxide + Water

Balanced symbol equation

$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + CO_2 + H_2O$

The total mass of the flask and its contents is measured over time and recorded on the graph below.

Change in mass over time



(b) (i) Why does the mass of the flask and its contents decrease during the reaction?

Overtime the n.o. reactant particles decrease and when they react together, they become bonded (product particles).

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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Subject	Science	Standard	90944	Total score	17

Q	Grade score	Annotation
1	M5	Part (a): explains groups and periods in relation to Na and Li i.e. both have one electron in valence shell (group) but different number of electron (not valence) shells. Li has 2 but Na has 3. Part (b): does not explain how F needs to gain one electron and Na lose one electron to have full valence shells (requirement for M and E) and become stable. Part (c): does not explain how ionic compounds need to have zero/no charge in relation to magnesium and fluorine and how this applies to Mg^{2+} and F^{-}. Explains that Mg loses 2 electrons but F can only accept one therefore 2Fs are needed by one Mg. Electron transfer is implied by diagrams and statement of ionic bond between Mg and F. (At E a full explanation of electron transfer and ionic bonding based on attraction of opposite charges is expected).
2	M6	Part (b): balanced chemical equation is correct. Part (c)): does not explain how H^{+} and OH^{-} combine to form water during neutralisation. Does link UI colours to concentration of ions and pH (concentration of ions **or** pH required for M) Explains how ratio of ions changes as more acid is added i.e. high excess of OH^{-} at beginning and high excess of H^{+} when colour change stops. Changing proportions of ions at each colour change expected and given by candidate.
3	M6	Part (a): formula equation is correct and balanced. Part (b)(i): does not link CO_2 escaping from flask with decrease in mass. Part (b)(ii): explains the risk of reaction in different sections and links to number of particles available for collision but not linked to mass decreasing due to CO_2 production (required for E). Part (c): Links the increased speed of particles (kinetic energy) with increased chance of successful collisions (production of product). Does not make the link that particles are colliding with more energy/force which increases chance of success (required for E).