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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.

Excellence

TOTAL 23

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QUESTION ONE

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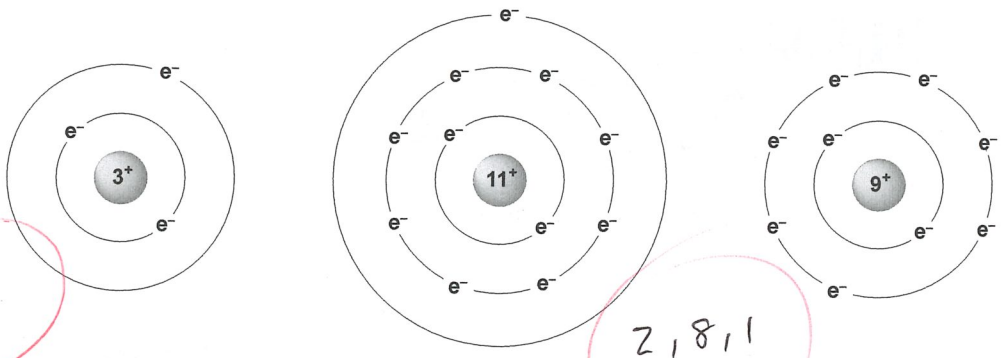
The diagrams show models of three different atoms:



2,1 Lithium

2,8,1 Sodium

2,7 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)?

Lithium and Sodium are in the same group, group 1 because both these atoms have 1 valence electron. However, Lithium and Sodium aren't in the same period or rownumber because they have different number of occupied shells. Lithium has 2 occupied shells so in row/period 2, whereas, sodium is in row/period 3 as Sodium has 3 occupied shells of electrons.

(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.

Sodium ion has the same electron arrangement as the Fluorine ion of 2,8. However the Sodium ion & fluorine ion charges are different. Since Sodium electron configuration is 2,8,1, in order to form Sodium ion & obtain full valence shell & stability, Sodium must lose 1 electron. Thus Sodium ion (Na^+) has a charge of +1 as there's one extra proton than electron. since the 11 proton (positive charge) - 10 electrons (negative charge) = +1

Thus sodium ion charge is +1 and Fluorine ion has same electron arrangement of 2,8 because Fluorine needs to gain 1 electron as Fluorine atom electron arrangement is 2,7 to have full valence shell and be stable. However, Fluorine ion charge isn't +1, it is -1 charge as there's 1 less protons than electrons since 9 protons (+ve charge) - 10 electrons (-ve charge) = -1 charge

So - Fluorine ion has -1 charge compared to sodium ion with +1 charge.

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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.

MgF_2 or magnesium ion to fluorine ion has a ratio of 1:2. This ratio is because since Mg has a electron arrangement of 2,8,2, Mg needs to lose 2 electrons to become Mg ion with a charge of +2 since 2 extra protons than electrons. Fluorine ion has a charge of -1 as Fluorine needs to gain 1 more electron to obtain full shell & be stable to form Fluorine ion with -1 charge since there's 1 less protons than electrons. Fluorine and Magnesium can form an ionic bond because since the electrostatic forces of attraction between a positive & negative charge ions cancel out = no charge. The ratio of Mg ion to F ion is 1:2 since we need 1 Mg ion to give 2 electrons to F since Mg ion has charge of +2 so needs to lose 2 electrons; however, since Fluorine ion has a charge of -1 so can only gain 1 electron from Mg ion, we need 2 Fluorine ions to recieve a total of 2 electrons from 1 Mg ion. Since ratio is 1:2 Mg to F, the charges can cancel out to form ionic compound due to ionic bond since $(1 \times +2) + (2 \times -1) = 0$ charge.

charge.

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.

Neutralisation reaction

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

Word equation

potassium hydroxide + sulfuric acid → potassium sulfate + water

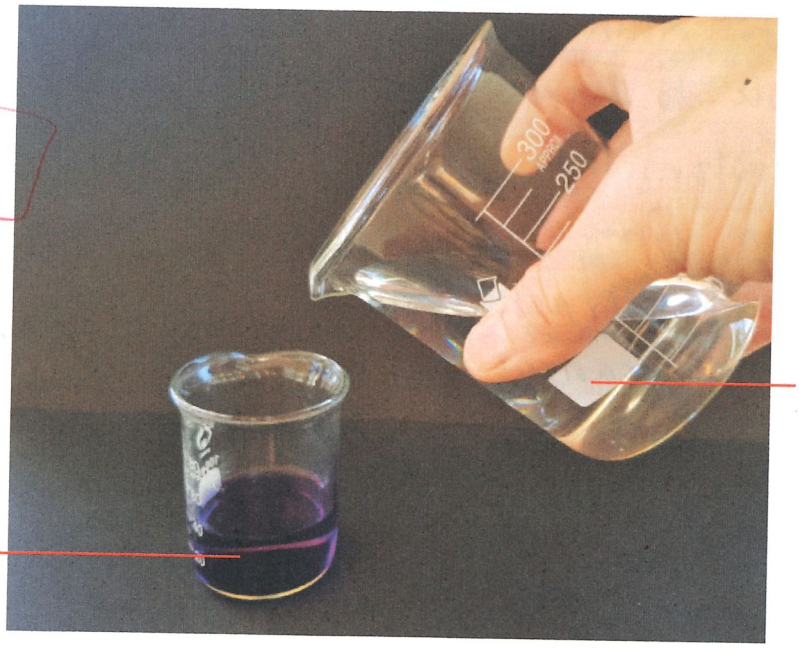
Balanced symbol equation

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

(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.**

Acid add to base



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 the acid (H_2SO_4) is added to the base (KOH) a neutralisation reaction will begin to happen as the H^+ ions/particles which come from H_2SO_4 slowly neutralise the OH^- ions which come from KOH base, eventually to form water. When the first drop of H_2SO_4 is added to KOH, the universal indicater will be purple as the pH is 12 to 14 and solution is very very basic with very little acidic so way more OH^- ions than H^+ ions. As more H_2SO_4 is added to KOH, the universal indicater will be blue as the pH of solution is now 8 to 11 and there's more OH^- ions than H^+ ions as solution is still more basic than acidic. As more H_2SO_4 is added to KOH, the solution will become neutral and form/produce H_2O ← water as there is equal amount of OH^- ions and H^+ ions. The universal indicator will be green as pH is now 7 and the solution neutral. As more H_2SO_4 is added to KOH, the solution will become more acidic than basic and universal indicator is yellow and pH of solution 4 to 6. This is because there's more H^+ ions than OH^- ions. As even more ☆ H_2SO_4 is added to KOH, the solution will be very very acidic and very little basic as the colour of the universal indicator is red showing that pH of solution is 0 to 3 and there will be way more H^+ ions than and very little amount of OH^- ions. This is a neutralisation reaction as an acid + base → salt + WATER.

☆ until all is added

E8

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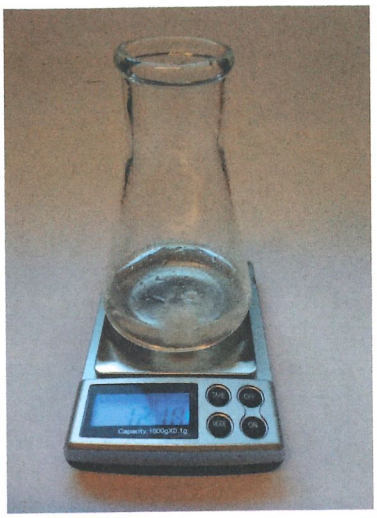
QUESTION THREE

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

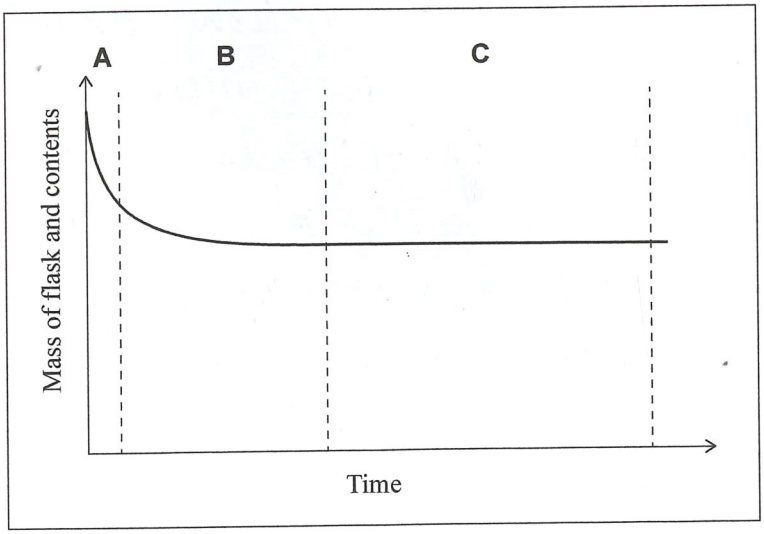
nitric acid + magnesium carbonate → magnesium nitrate + water + carbon dioxide

Balanced symbol equation

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

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?

mass decreases as particles are used up and because CO_2 gas is produced it decreases the mass of flask & its contents.

(ii) Explain what is happening in sections A, B, and C of the graph.

Link your answer to rates of reaction and particle collisions.

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In section A, the mass of the contents decreases at a high fast rate since the concentration of the HNO_3 or H^+ ions is the highest so increase reaction rate with $MgCO_3$ and produces CO_2 the fastest causing mass decrease fastest. In SA since when concentration increases there is more particles (H^+) per unit volume so more frequent successful collisions leading to faster rate of reaction. Thus in Section B, the contents of mass is still decreasing, but at a slower rate than Section A since concentration of particles is decreasing as CO_2 is being produced so mass decrease slows down. However, in section C, the mass has stopped decreased since the reaction has stopped and all of the CO_2 product gas has been produced as all particles used up and there is no more concentration of particles left to react.

(c) Explain how increasing the **temperature** will make the reaction between magnesium carbonate and nitric acid faster.

Link your answer to rates of reaction and particle collisions.

By increasing the temperature of the nitric acid where H^+ ions come from between this acid and $MgCO_3$, it will increase the rate of reaction faster. This is because when temperature increases, the particles of H^+ ions in HNO_3 & $MgCO_3$ particles move faster resulting in more kinetic energy between particles. This means there is more frequent and successful particle collisions and overall the temp increase of the HNO_3 and $MgCO_3$ will mean a faster rate of reaction.

E7

Subject	Science	Standard	90944	Total score	23

Q	Grade score	Annotation
1	E8	Part (b): clearly explains why the 2 ions have the same electron arrangement – 2, 8 – by Na losing one negatively charged electron to have a full, stable valence shell. F or F^- also have the arrangement 2, 8 but gain one negatively charged electron to gain a full, stable, outer shell. The difference to the charges is because Na^+ now has one more positive charge than negative, whereas F^- now has 1 more negative charge than positive. Part (c): fully explained the ratio of 1 Mg to 2 F. Clearly states the two electrons lost by Magnesium have been gained, one each by fluorine. Clearly states the charges are balanced = zero.
2	E8	Part (b): fully balanced correct symbol equation. Part (c): fully explains and links colour changes to changing, lowering pH to relative concentration of H^+ and OH^- ions. Neutralisation reaction has occurred when universal indicator is green and pH H^+ plus OH^- combine to form water.
3	E7	Part (a): gives correctly balanced symbol equation. Part (b)(i): did not talk about gas escaping but by linking it to the mass in the flask and the rate of reaction this is clearly implied and understood. Part (b)(ii): full explanation of the reaction at each stage linking number/concentration of particles available for collision with the reaction rate AND the amount/rate of CO2 produced and loss of mass. Part (c): E point not given as the candidate did not clearly explain that particles collide more often and with greater energy/force which leads to a greater number of successful collisions in a unit of time.