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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Science 2023

90944 Demonstrate understanding of aspects of acids and bases

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.

Make sure that you have Resource Booklet L1–SCIER.

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

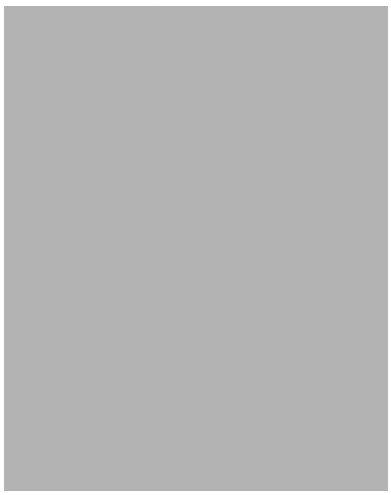
Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

QUESTION ONE

Harakeke (flax) is used to make taonga (treasures) like kete (bags) and kākahu (clothing). It can be dyed black with paru (mud).



Source: www.hetetart.com/mum-s-raukura

After the dyeing is complete, the acidic paru (mud) can damage the taonga if left too long. To stop the damage, the acid needs to be removed.

(a) (i) Choose the substance that would be best suited to remove the acid.

Circle the correct answer.

ethanoic acid **sodium hydroxide**

(ii) Explain why you chose this answer.

(b) Hot acidic paru (mud) can dye fibres quicker than cold acidic paru (mud).

Use collision theory to explain why increasing the temperature increases this rate of reaction.

(c) Some muds contain calcium oxide, CaO.

Explain the ratio of calcium ions to oxide ions in CaO.

In your answer you should explain:

- how the ratio is related to the charge on the ions
- the number of electrons gained or lost by each atom as it forms the ionic compound.

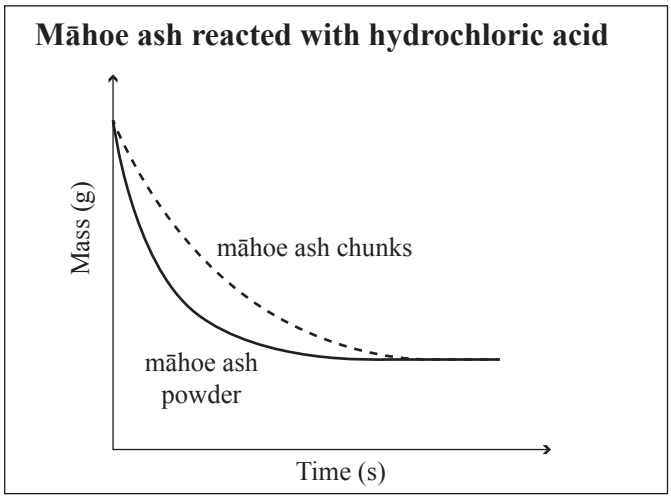
QUESTION TWO

Māhoe is a wood that is traditionally used to make open fires in Aotearoa New Zealand. When the wood is burnt, ash is left behind. This ash can be used to neutralise acids in soils and help support plant growth.

Māhoe tree	Māhoe ash powder	Māhoe ash chunks
		
Source: https://tawabush.org.nz/2022/03/28/know-the-native-trees-in-tawa-reserves-with-gil-roper-melicytus-ramiflorus-mahoe-whitey-wood/	Source: www.diyncrafts.com/101312/home/gardening/15-clever-ways-to-use-wood-ash-in-the-garden	Source: www.dreamstime.com/photos-images/ash-ember.html

Ash is a mixture of sodium carbonate and potassium carbonate, and other chemicals.

One-kilogram samples of māhoe ash were each reacted with the same volume of hydrochloric acid solution in separate open flasks. One sample was māhoe ash powder, the other was māhoe ash chunks. The mass of māhoe ash was measured, and a graph was plotted.

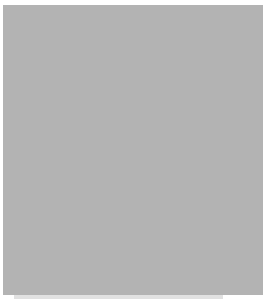


(a) (i) State which type of māhoe ash had the higher rate of reaction.

(ii) Use collision theory to explain why the rate of reaction at the start of the two reactions is different for māhoe ash powder and māhoe ash chunks.

(iii) Explain why the final masses of the two flasks were the same.

A blue solution is made by mixing ash with water and filtering. It has universal indicator added to it.



This solution then has hydrochloric acid added to the beaker, drop by drop.

Source: https://simple.wikipedia.org/wiki/Universal_indicator#/media/File:OGLED_pH_SKALA.JPG

(b) Explain in detail what happens to the colour observed while the hydrochloric acid is being added to the ash solution.

Link your answer to the concentrations of H^+ and OH^- ions, and the changing pH of the solution.

(c) Complete the word and symbol equations for the reactions that take place.

sodium carbonate + hydrochloric acid →

Balanced symbol equation:

potassium carbonate + hydrochloric acid →

Balanced symbol equation:

QUESTION THREE

Potassium is a metal. Phosphorus is a non-metal.

(a) Write the electron arrangement for each of these atoms.

Potassium: _____

Phosphorus: _____

(b) (i) Potassium and phosphorus atoms both form ions with the same electron arrangement.

Write the electron arrangement of these two ions.

Potassium ion, K^+: _____

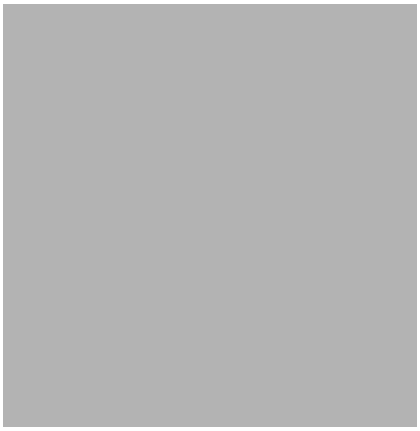
Phosphorus ion, P^{3-}: _____

(ii) Explain how each ion, K^+ and P^{3-}, is formed.

In your answer you should:

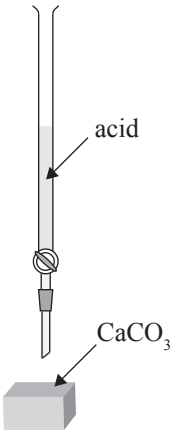
- explain why these elements form ions
- explain the charges on both ions in terms of electron arrangement of atoms and ions, number of protons and number of electrons, and overall charge.

(c) The rocks of the Waitomo area are made of calcium carbonate. These rocks react with acid in rain to produce holes.



Source: https://www.doc.govt.nz/parks-and-recreation/places-to-go/waikato/places/waitomo-area/tracks/marokopa-falls-walk/

The following reaction is shown in a school laboratory.



A **less concentrated** acidic rain solution was dripped at a steady rate on to a piece of calcium carbonate, $CaCO_3$. The time taken to make a hole through the calcium carbonate was measured.

The experiment was repeated with an identical piece of calcium carbonate, but this time with a **more concentrated** solution of acidic rain. All other environmental factors were kept the same for all repeats.

(i) Circle the acidic rain solution that takes the shortest time to react through the calcium carbonate.

more concentrated solution **less concentrated solution**

(ii) Use collision theory to explain why the rate of reaction of the two acidic rain concentrations is different.

There is more space for your answer to this question on the following page.

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

QUESTION NUMBER

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