Acids, Alkalis and pH

From the pH scale to neutralisation reactions, understanding acids and alkalis is a core part of KS3 chemistry and a foundation for GCSE Science.

7. Michelle added some universal indicator solution to four liquids.

Michelle uses the pH chart to fill in her table of results.

pH chart

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
colour	red			orange			green	blue			purple			

(a) The table below shows some of Michelle's results.

Complete Michelle's table of results below.
Use the pH chart to help you.

liquid	colour of universal indicator solution	pH
milk	green	
rain water		5
hydrochloric acid	red	
bleach		11

7a
1 mark

7a
1 mark

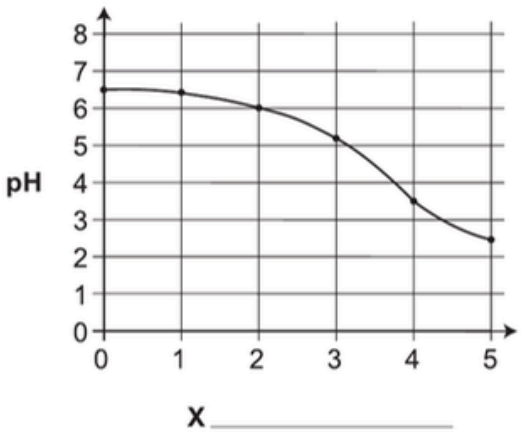
(b) Explain why using acids can be dangerous.

7b
1 mark

KS3 Science SATs, Tier 3-6, Paper 1 (2009) - Q7(a)

(c) Michelle measured the pH of some milk stored at room temperature for five days.

The graph of Michelle's results is shown below.
One of the axes has been labelled.



(i) Write the axis label for the graph **at X.**

7ci
1 mark

(ii) Use the graph. How does the pH of the milk change over the five days?

_____

7cii
1 mark

KS3 Science SATs, Tier 3-6, Paper 1 (2009) - Q7(b)-(c)

1 mark

(e) Complete the word equation for the reaction between citric acid and calcium carbonate. Use the equation in part (a) to help you.

citric acid + calcium carbonate → water + _____ + _____

12e
1 mark

KS3 Science SATs, Tier 5-7, Paper 2 (2009) - Q12(e)

13. Burning fossil fuels causes air pollution.

(a) (i) Give the names of **two** fossil fuels.

13ai

1 mark

_____ and _____

(ii) Some fossil fuels contain sulphur.

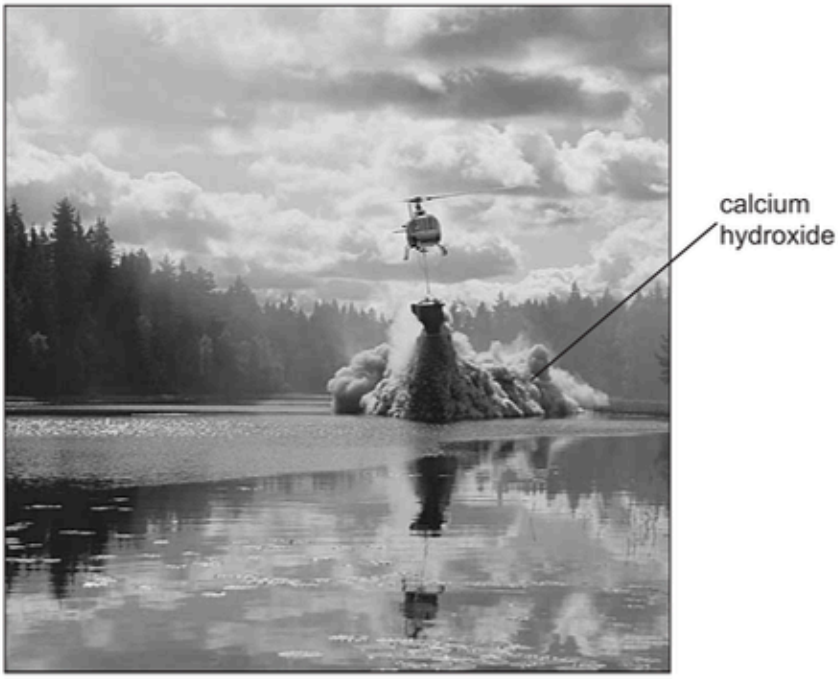
Complete the word equation for the reaction between sulphur and oxygen in the air.

13aii

1 mark

sulphur + oxygen → _____

(b) Burning fossil fuels leads to the formation of acid rain.
Acid rain has collected in this lake.
A helicopter is dropping calcium hydroxide into the lake.



Modern Tuition

Calcium hydroxide dissolves in water to form an alkaline solution.

(i) What effect does an alkali have on the pH of an acidic lake?

_____

13bi
1 mark

(ii) When calcium hydroxide reacts with sulphuric acid in the lake a calcium salt is formed.

What is the name of this salt?
Tick the correct box.

calcium carbonate	☐	calcium chloride	☐
calcium nitrate	☐	calcium sulphate	☐

13bii
1 mark

(c) The photograph below shows trees damaged by acid rain.



(i) The trees have lost their leaves and have died.
Explain why leaves are needed for a tree to grow.

_____

_____

13ci
1 mark

(ii) What effect does acid rain have on buildings made from limestone?

_____

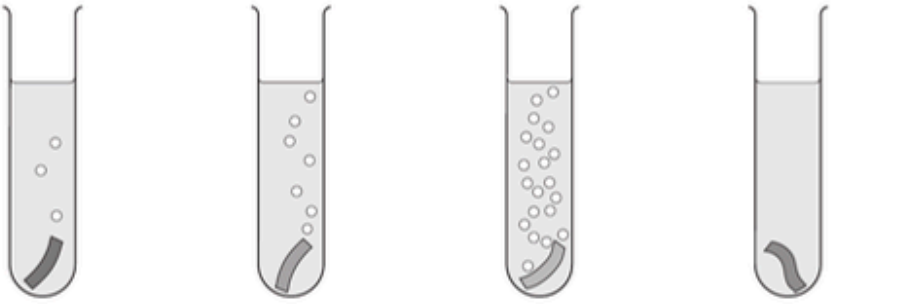
_____

13cii

Modern Tuition

4. (a) Ruth put a piece of a different metal in each of four test tubes.

She poured 10 cm^3 of hydrochloric acid onto each metal.



iron + hydrochloric acid | **zinc** + hydrochloric acid | **magnesium** + hydrochloric acid | **copper** + hydrochloric acid

Look at the diagrams above.

(i) How do these show if a metal reacts with the acid?

_____

4ai
1 mark

(ii) **On the lines below**, put the **four** metals in the order of how strongly they react with the acid.

most reactive _____

_____

_____

least reactive _____

4aii
1 mark

Modern Tuition

4. Table 1 below shows the colour of universal indicator in acidic, neutral and alkaline solutions.

	acidic ←			neutral	alkaline →		
colour of indicator	red	orange	yellow	green	blue	dark blue	purple

table 1

Ramy tested different liquids with the indicator solution.
His results are shown in table 2 below.

liquid	colour of indicator solution
milk	green
lemonade	orange
water	green
fruit juice	red
washing-up liquid	blue

table 2

(a) Use Ramy's results to answer the following questions.

(i) Give the name of **one** acidic liquid in **table 2**.

4ai

1 mark

_____

(ii) Give the name of **one** neutral liquid in **table 2**.

4aii

1 mark

_____

Modern Tuition

(b) Ramy dissolved some bicarbonate of soda in distilled water.
This produced an alkaline solution.

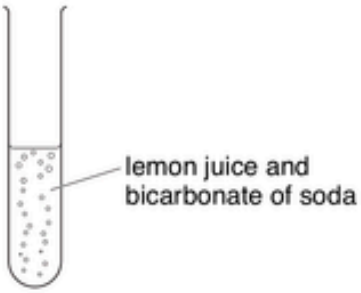
(i) Ramy added the indicator to the alkaline solution.

Suggest what colour the indicator became.
Use **table 1**, on the opposite page, to help you.

_____

4bi
1 mark

(ii) Ramy added lemon juice to the solution of bicarbonate of soda.



How could he tell that a gas was produced?

_____

4bii
1 mark

(c) Ramy mixed an acid with an alkali and tested the mixture with the indicator solution.
The indicator solution turned green.

What is the name of the reaction between an acid and an alkali?
Tick the correct box.

condensation ☐

crystallisation ☐

evaporation ☐

neutralisation ☐

4c
1 mark

Modern Tuition

11. Molly used a pH sensor to test different liquids. She dipped the probe of the sensor into each liquid and recorded the pH value in a table.



(a) In the table below, tick **one** box for each liquid to show whether it is **acidic**, **neutral** or **alkaline**. One has been done for you.

liquid	pH value	acidic	neutral	alkaline
alcohol	7			
dilute hydrochloric acid	2	✓		
distilled water	7			
vinegar	3			
sodium hydroxide solution	11			

11a
1 mark

11a
1 mark

(b) Between each test Molly dipped the probe into distilled water.

(i) Why did she do this?

_____

_____

11bi
1 mark

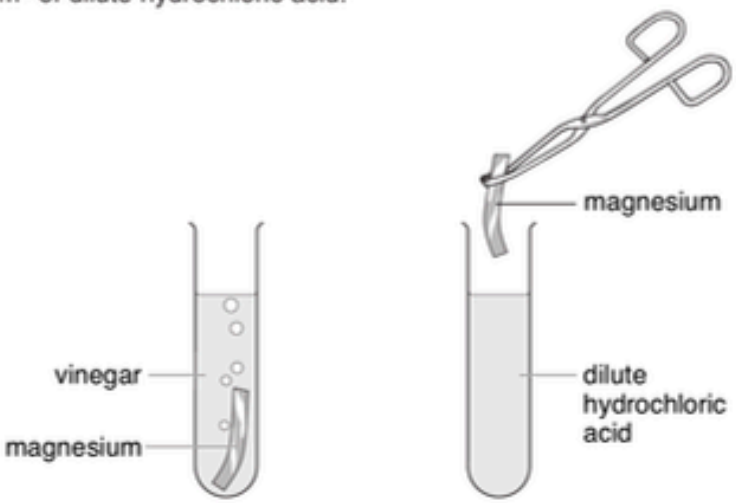
(ii) Which other liquid in the table could Molly use between tests to have the same effect as distilled water?

_____

11bii
1 mark

Modern Tuition

(c) Molly put a piece of magnesium into a test-tube containing 20 cm^3 of vinegar. She put another piece of magnesium into a test-tube containing 20 cm^3 of dilute hydrochloric acid.



(i) Molly thought that magnesium would react more vigorously with hydrochloric acid than with vinegar.
What information in the table made Molly think this?

_____

_____

11ci
1 mark

(ii) How would Molly be able to tell if a more vigorous reaction took place with hydrochloric acid than with vinegar?

_____

_____

11cii
1 mark

(d) (i) Complete the word equation for the reaction between magnesium and hydrochloric acid.

11di
1 mark

magnesium + hydrochloric acid → _____ + _____

11di
1 mark

(ii) After some time this reaction stopped. Why did the reaction stop?

_____

_____

11dii
1 mark

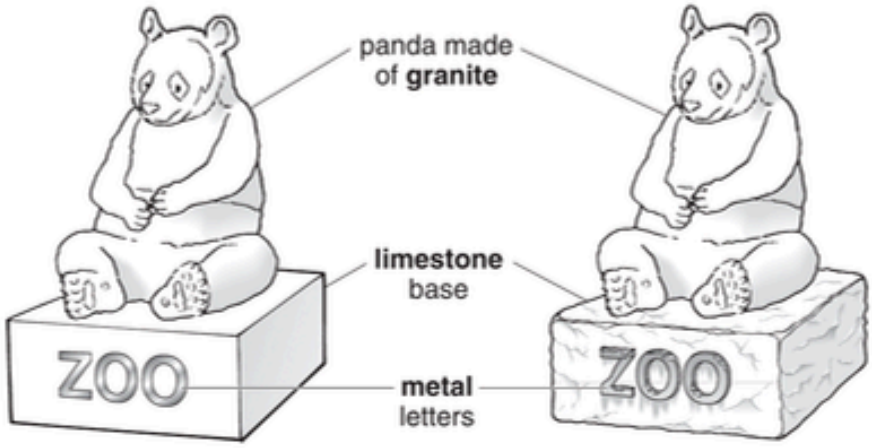
maximum 9 marks

Modern Tuition

4. A statue outside a zoo was made from two types of rock.

The panda was made of granite.
The base was made of limestone.

The drawings show the statue as it was in 1936 and in 2006.



statue in 1936 statue in 2006

(a) The surface of the limestone base has changed over the years.

(i) Which process caused this change?
Tick the correct box.

evaporating	☐	melting	☐
reflecting	☐	weathering	☐

☐ 4ai
1 mark

(ii) The surface of the panda made of granite has **not** changed.

Suggest why granite does **not** change in the same way as limestone.

_____

_____

☐ 4aii
1 mark

Modern Tuition

(b) Acid rain can be formed when fossil fuels burn.

(i) Give the name of **one** fossil fuel.

_____

☐ 4bi
1 mark

(ii) What is true about all fossil fuels?
Tick the correct box.

All fossil fuels are a source of energy.	☐	All fossil fuels are black.	☐
All fossil fuels are liquid.	☐	All fossil fuels take less than 50 years to form.	☐

☐ 4bii
1 mark

(iii) Acid rain has changed the surface of the metal letters on the statue.

Which word describes the effect of acid rain on a metal?
Tick the correct box.

corrosion	☐	friction	☐
magnetism	☐	vibration	☐

☐ 4biii
1 mark

(iv) What could the zoo owner put on the metal letters to protect them from acid rain?

_____

☐ 4biv
1 mark

Modern Tuition

(b) Sharna mixed the purple cabbage-water with some other liquids.
She wrote the colours of the mixtures in a table as shown below.

	colour of cabbage-water mixed with liquid	Is the liquid acidic, alkaline or neutral?
liquid 1	red	acidic
liquid 2	blue	alkaline
liquid 3	purple	neutral

Use the information in the table to answer parts (i) and (ii) below.

(i) Sharna mixed cabbage-water with colourless washing-up liquid.
The mixture turned **blue**.

What does this tell you about the washing-up liquid?

_____

5bi
1 mark

(ii) Sharna then mixed cabbage-water with lemon juice.
Lemon juice is **acidic**.

What colour was the mixture?

_____

5bii
1 mark

(c) What is the name of a chemical which changes colour when it is mixed with acids or alkalis?
Tick the correct box.

filtrate	☐	indicator	☐
non-metal	☐	solution	☐

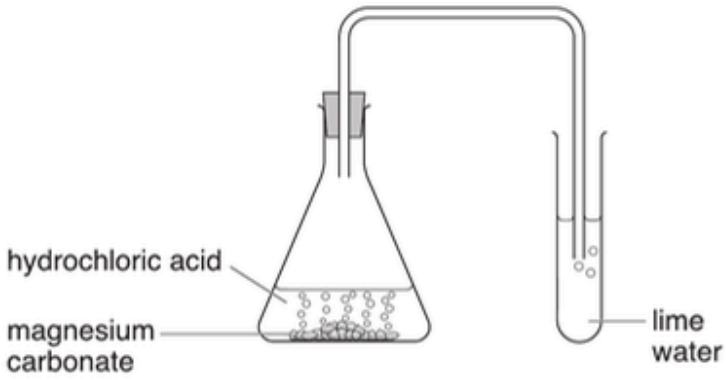
5c
1 mark

Modern Tuition

12. The word equation for the reaction between magnesium carbonate and hydrochloric acid is shown below.

magnesium carbonate + hydrochloric acid → magnesium chloride + carbon dioxide + water

(a) Sadiq added hydrochloric acid to magnesium carbonate in a flask.



(i) Suggest the pH of hydrochloric acid.

_____

12ai
1 mark

(ii) The carbon dioxide produced was bubbled through lime water.

How would the lime water change?

_____

12aii
1 mark

(b) Sadiq repeated the experiment by adding **sulphuric acid** to magnesium carbonate.

Complete the word equation for the reaction that took place.

magnesium carbonate + sulphuric acid → _____ + carbon dioxide + water

12b
1 mark

Modern Tuition

11. Paul had four substances:

citric acid	copper sulphate	indigestion tablet	sugar

He dissolved 1 g of each substance in 20 cm^3 of distilled water.
He used universal indicator to find the pH of each solution.

(a) (i) Sugar solution does **not** change the colour of green universal indicator.

What does this tell you about sugar solution?
Tick the correct box.

It is an acid.	☐	It is an alkali.	☐
It is neutral.	☐	It is sweet.	☐

☐ 11ai
1 mark

(ii) Suggest the pH of citric acid.

_____

☐ 11aii
1 mark

(iii) Indigestion tablets neutralise acid in the stomach.

What does this tell you about indigestion tablets?

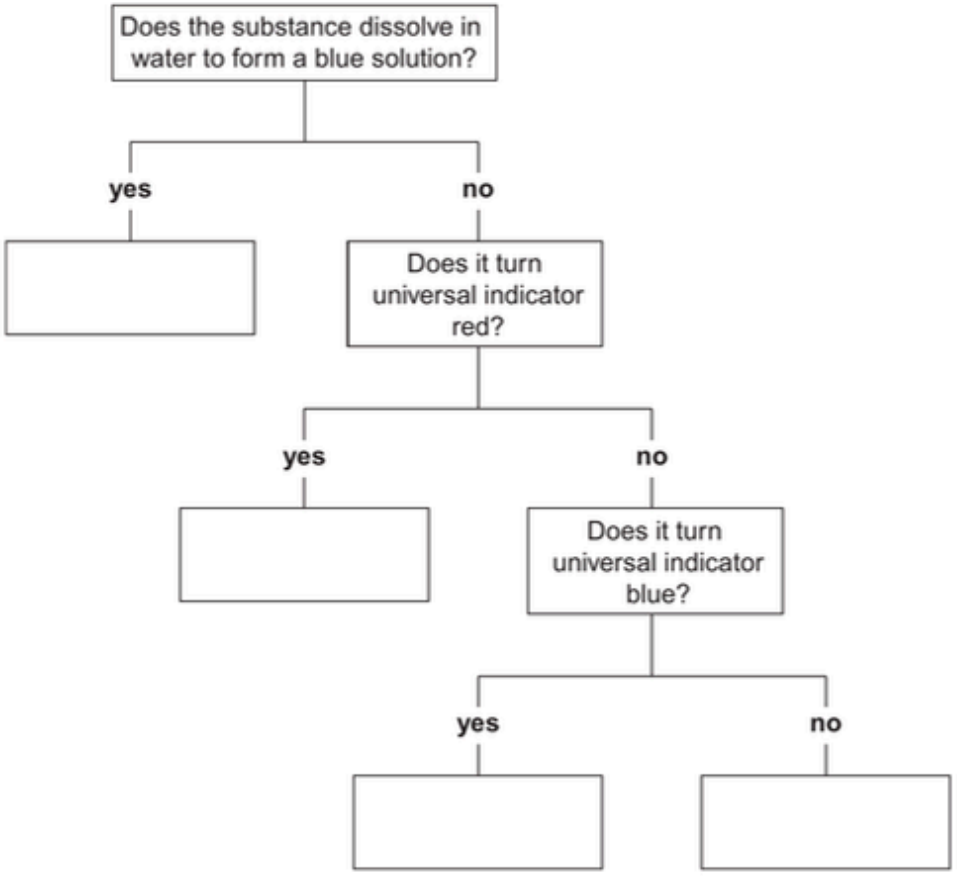
_____

☐ 11aiii
1 mark

Modern Tuition

(b) Complete the flow chart below with the names of the substances in the boxes.

citric acid **copper sulphate** **indigestion tablet** **sugar**



11b
1 mark

11b
1 mark

11b
1 mark

9. (a) The table below shows the pH of four acidic liquids.

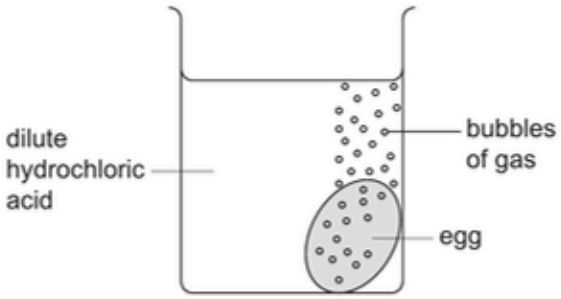
acidic liquid	pH
grapefruit juice	3.1
ethanoic acid	3.0
lemonade	4.4
dilute hydrochloric acid	1.0

Which of these liquids is the **least** acidic?

9a

1 mark

(b) Emilio cooked an egg until it was hard-boiled.
He put the egg in a beaker of dilute hydrochloric acid as shown.



(i) The egg shell reacted completely with the acid.
After two days the pH of the liquid in the beaker was 2.5.

How did the **acidity** of the liquid in the beaker change?
Use the table above to help you.

9bi

1 mark

Modern Tuition

(ii) Emilio put another hard-boiled egg in some ethanoic acid.
It took longer for the shell to react completely.

Use the table opposite to suggest a reason for this.

_____

_____

9bii
1 mark

(c) The chemical formulae for four acids are shown in the table below.

sulphuric acid	hydrochloric acid	nitric acid	ethanoic acid
H_2SO_4	HCl	HNO_3	CH_3COOH

(i) Give the **name** of the element that is present in all four acids.

_____

9ci
1 mark

(ii) Give the **names** of the two **other** elements present in sulphuric acid.

1. _____

2. _____

9cii
1 mark

9cii
1 mark

(iii) How many atoms are there in the formula HNO_3 (nitric acid)?

_____

9ciii
1 mark

Modern Tuition

12. (a) The chemical formula for hydrochloric acid is HCl.
The chemical formula for sodium hydroxide is NaOH.

When they react together, two products are formed.
The chemical formula for one product is NaCl.

(i) Complete the word equation below with the **names** of both products.

(ii) **On the dotted line**, give the chemical formula of the other product.

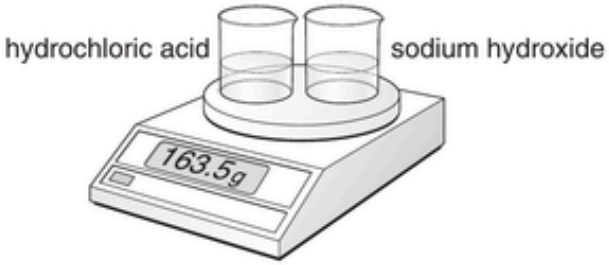
12ai
1 mark

12ai
1 mark

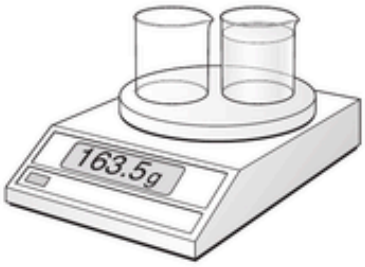
12aii
1 mark

sodium hydroxide (NaOH) + hydrochloric acid (HCl) → _____ + _____
NaCl

(b) In experiment 1, Molly put two beakers on a balance.
One contained 20 cm^3 of hydrochloric acid.
The other contained 20 cm^3 of sodium hydroxide solution.
The total mass was 163.5 g.



She poured the acid onto the sodium hydroxide. They reacted.



Why did the reading on the balance **not** change?

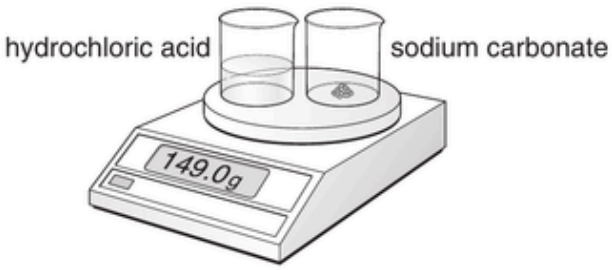
_____

_____

12b
1 mark

Modern Tuition

(c) In experiment 2, Molly put two beakers on a balance.
One contained 20 cm^3 of hydrochloric acid.
The other contained 5 g of sodium carbonate.



She poured the acid onto the sodium carbonate. They reacted.
Two of the products are the same as in experiment 1.

(i) Complete the word equation with the names of the **three** products.

sodium carbonate + hydrochloric acid → _____ + _____ + _____

12ci
1 mark

(ii) The total mass at the start was 149.0 g.
When the reaction stopped, the reading on the balance was 147.0 g.

Why was there a loss of mass in this reaction?

_____

_____

12cii
1 mark

Modern Tuition