Chemistry Unit C1: Structures, Trends, Chemical Reactions, Quantitative Chemistry and Analysis

C1.8 Acids, Bases and Salts

Content - CCEA Double Award Chemistry 1 - Fort Hill Integrated College	Got it	Nearly	Haven't a clue
C1.8 Acids, Bases and Salts			
Indicators and pH			
Can you describe the effects of acidic, alkaline and neutral solutions on indicator papers (red and blue litmus papers and universal indicator paper) and the use of a pH meter to give pH data to at least one decimal place;			
Can you interpret given data about universal indicator (colour or pH) to classify solutions as acidic, alkaline or neutral and to indicate the relative strengths of acidic and alkaline solutions according to the following classification: • pH 0-2 strong acid; • pH 3-6 weak acid; • pH 7 neutral; • pH 8-11 weak alkali; and • pH 12-14 strong alkali;			
Can you recall that acids dissolve in water to produce hydrogen ($H^+_{(aq)}$) ions;			
Can you recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH;			
Can you recall that alkalis dissolve in water to produce hydroxide ($OH^-_{(aq)}$) ions; and			
Can you demonstrate knowledge and understanding that strong acids and strong alkalis are completely ionised in water, recall examples of strong acids (including hydrochloric acid, sulfuric acid and nitric acid) and recall examples of strong alkalis (including sodium hydroxide and potassium hydroxide).			
Can you recall that weak acids and weak alkalis are partially ionised in water, recall examples of weak acids (including ethanoic acid and carbonic acid) and recall examples of weak alkalis (including ammonia);			
Can you explain dilute and concentrated in terms of the amount of substances in solution;			

Reactions of acids			
Can you describe neutralisation as the reaction between the hydrogen ions in an acid and the hydroxide ions in an alkali to produce water **and recall the ionic equation as:** $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$			
Can you describe how to investigate the temperature change during neutralisation and recall that neutralisation reactions are exothermic (heat is given out);			
Can you recall that a base is a metal oxide or hydroxide that neutralises an acid to produce a salt and water and that an alkali is a soluble base;			
Can you demonstrate knowledge and understanding of and write observations on and equations for the general reactions of hydrochloric, sulfuric and nitric acids with: • metals; • bases; • carbonates; and • hydrogencarbonates;			
Can you describe how to test for hydrogen gas: apply a lighted splint and a popping sound results; and			
Can you describe how to test for carbon dioxide: limewater (calcium hydroxide solution) will change from colourless to milky if the test is positive.			
Salts			
Can you recall that a salt is a compound formed when some or all of the hydrogen ions in an acid are replaced by metal ions or ammonium ions;			
Can you demonstrate knowledge and understanding that most Group 1 (I), Group 2 (II), aluminium and zinc salts are white and if they dissolve in water they give colourless solutions, and that transition metal salts are generally coloured;			
Can you explain the importance of safety in the laboratory to assess potential risks, including the hazards associated with chemicals labelled with the GHS/CLP international chemical hazard labelling (including toxic, corrosive, flammable, explosive and caution); and			
Can you describe how to investigate the reactions of acids, including temperature changes that occur ***(Prescribed Practical C1)****.*			

A

Examiner Only	
Marks	Remark

1 **(a)** Indicators can change colour in acid and alkaline solutions. Indicators can be made from plant material such as red cabbage.

The table below gives information about three different indicators. Use this information to answer the questions that follow.

Substance	Colour of universal indicator paper	Colour of red litmus paper	Colour of red cabbage solution	pH range
hydrochloric acid	red	red	red	1–2
sodium hydroxide	dark blue	blue	yellow	12–14
water	green	red	purple	7
ethanoic acid	orange	red	red	3–6

(i) Why is red litmus paper **not** a suitable indicator for testing pH?

_____

_____ [1]

(ii) Explain why red cabbage solution can be described as an indicator.

_____

_____

_____

_____ [2]

(iii) Why is universal indicator a better indicator than red cabbage solution for testing acids?

_____

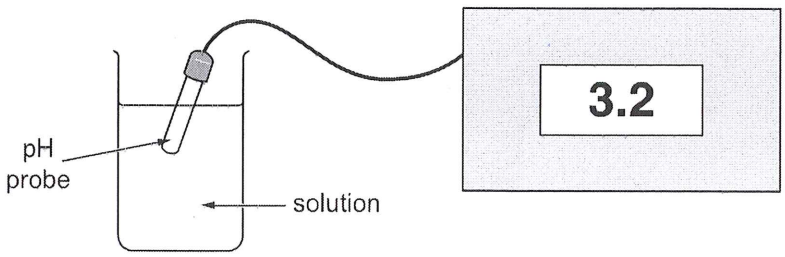
_____

_____ [1]

B

Examiner Only	
Marks	Remark

(b) The diagram below shows a way of measuring pH.



Give an advantage of using a pH probe instead of an indicator solution to measure pH.

_____ [1]

(c) When copper(II) carbonate reacts with an acid it forms copper(II) sulfate. Complete the word equation for this reaction.

copper(II) carbonate + → copper(II) sulfate + +

[3]

(d) The colour of copper(II) sulfate crystals changes as they are heated.

The colour and formulae of three types of copper(II) sulfate are given in the table below.

Colour	Formula
blue	$CuSO_4.5H_2O$
green	$CuSO_4.H_2O$
white	$CuSO_4$

(i) Give the formula of the type of copper(II) sulfate that would be best to test for the presence of water.
Explain your answer.

Formula: _____ [1]

Explanation: _____

_____ [2]

(ii) What word is used to describe white copper(II) sulfate?

_____ [1]

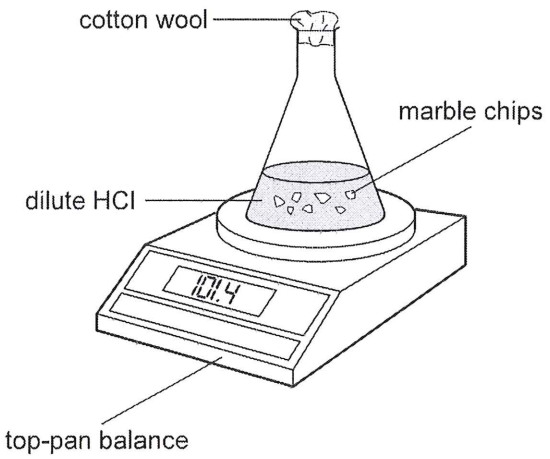
C1 H Feb 2013

C

2 A pupil investigated the reaction between calcium carbonate (marble chips) and dilute hydrochloric acid. He used excess calcium carbonate.

The equation for this reaction is:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$



The student measured the mass of the flask and its contents every minute for 8 minutes. The results are shown in the table below.

Mass/g	102.8	101.4	100.3	99.5	99.3	99.2	99.1	99.0	99.0
Time/min	0	1	2	3	4	5	6	7	8

(a) What is the name of the salt produced during the reaction?

_____ [1]

(b) What caused the mass of the flask and contents to decrease?

_____ [1]

H Nov '15

D

(c) Suggest why the student used **excess** calcium carbonate.

_____

_____ [1]

(d) Give an **accurate** way of checking that the resulting solution was neutral.

_____ [1]

(e) Another student in the same class used calcium oxide instead of calcium carbonate. He observed no drop in mass. Explain why this would be the case.

_____

_____ [2]

[Turn over

H Nov '15

E

2 Sulfuric acid is a strong acid. It reacts with sodium hydroxide according to the word equation below:

sodium hydroxide + sulfuric acid → sodium sulfate + water

Examiner Only	
Marks	Remark

(a) Write a balanced symbol equation to describe the reaction between sodium hydroxide and sulfuric acid.

_____ [3]

(b) Why is this reaction described as a **neutralisation** reaction?

_____

_____ [2]

(c) Why is sulfuric acid described as a **strong** acid?

_____

_____ [1]

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F

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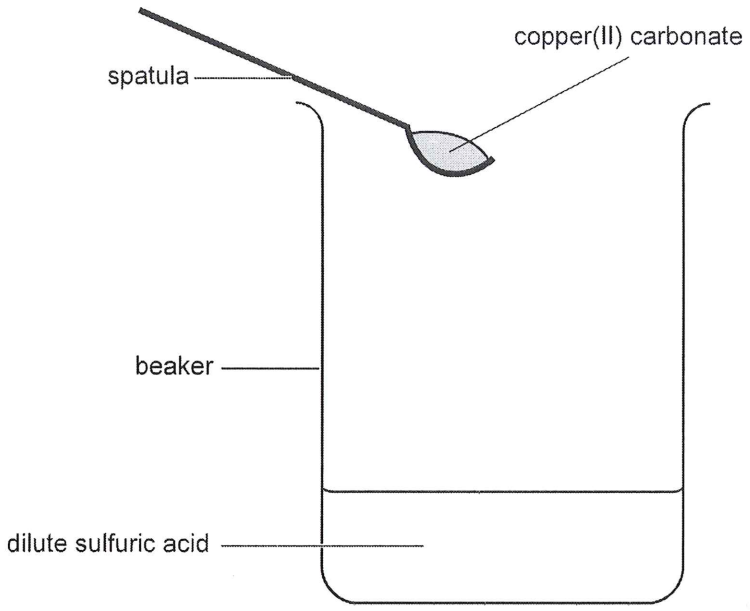
Marks	Remark

(d) A sample of solid copper(II) carbonate is added to dilute sulfuric acid as shown in the diagram below.



(i) What is the colour of solid copper(II) carbonate?

_____ [1]

(ii) Describe what can be observed happening in the beaker after the copper(II) carbonate is added to the dilute sulfuric acid.

_____

_____

_____

_____

_____ [4]

(e) Sulfuric acid reacts with magnesium to produce hydrogen gas. Describe a test for hydrogen gas.

_____

_____

_____ [2]

C1 H Nov 2014

G

Examiner Only	
Marks	Remark

3 Metal oxides are bases. They react with strong acids to form salts.

(a) What is the pH range of a strong acid?

_____ [1]

Copper oxide reacts with sulfuric acid.

(b) (i) Complete the **word** equation below for this reaction.

copper oxide + sulfuric acid → + [2]

(ii) Why can this reaction be described as a neutralisation reaction?

_____

_____ [2]

(iii) What colour change is observed **in the solution** as this reaction is happening?

from _____ to _____ [2]

Sodium oxide reacts with hydrochloric acid.

(c) (i) Complete a balanced symbol equation for the reaction between sodium oxide and hydrochloric acid.

Na_2O + HCl → + [3]

(ii) Sodium oxide is an alkali. Why could sodium oxide be described as an alkali?

_____

_____ [2]

H Nov '15

H

Examiner Only	
Marks	Remark

3 Magnesium chloride is produced in one type of fire extinguisher by the reaction of acid A and the base, magnesium hydroxide.

(a) Name acid A which reacts with magnesium hydroxide to produce magnesium chloride.

_____ [1]

(b) Suggest a reason why magnesium hydroxide is described as a base and not as an alkali.

_____ [1]

(c) Explain why the reaction between acid A and magnesium hydroxide is a neutralisation reaction.

_____

_____ [1]

Magnesium chloride is also formed by the reaction of magnesium oxide and acid A.

(d) What would you expect to observe when acid A is added to magnesium oxide?

_____

_____ [2]

C1 H June 2014

I

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Marks	Remark

(e) A solution of 0.05 mol/dm^3 acid Y was tested using a pH meter and universal indicator paper. The results are recorded in the table below.

Test	Result
pH meter	pH = 3.03
Universal indicator	orange pH = 3

(i) Explain how the colour of universal indicator is used to give a pH value.

_____

_____ [1]

(ii) How do the results show that acid Y is a weak acid?

_____

_____ [1]

(iii) Give one example of a weak acid.

_____ [1]

(iv) Which property of the acid is measured in the units mol/dm^3? Circle the correct answer.

mass **volume** **concentration** **strength**

[1]

Cl H June 2014

5

4 The table below gives information about the salts formed when metal carbonates react with acids.

Metal carbonate	Acid used	Cation in salt	Anion in salt	Formula of salt produced
calcium	hydrochloric	Ca^{2+}		$CaCl_2$
sodium		Na^+	SO_4^{2-}	
	sulfuric	Cu^{2+}		$CuSO_4$
magnesium	nitric			$Mg(NO_3)_2$

(a) Complete the table. [4]

(b) One of the reactions shown in the table involves a colour change. Give the **colours** of the starting metal carbonate and the salt solution produced:

metal carbonate colour: _____

colour of salt solution produced: _____ [2]

(c) All of the reactions shown in the table produce the same gas. Name this gas and describe a test that is used to identify it.

Name: _____

Test: _____

_____

_____ [3]

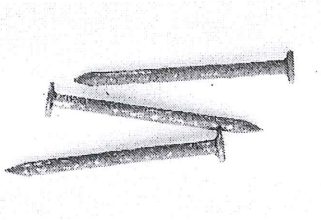
Examiner Only	
Marks	Remark

H Feb '15

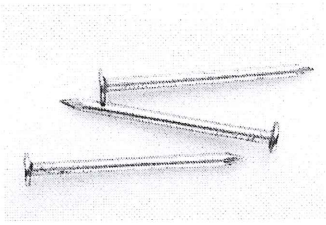
(K)

Examiner Only	
Marks	Remark

6 Nails made from iron rust easily. The rust can be removed using phosphoric acid.



rusty nails



nails after using phosphoric acid

The word equation for the reaction is given below.

phosphoric acid + iron oxide ⟶ iron phosphate + water

(a) Name the **base** in the word equation above.

_____ [1]

(b) Explain why this reaction is a neutralisation reaction.

_____

_____ [2]

The symbol for the phosphate ion is PO_4^{3-}

(c) Use this information to write the formula for phosphoric acid.

_____ [2]

Aluminium can be added to the iron to make an **alloy** which will not rust.

(d) What is an alloy?

_____

_____ [2]

May 2013 C1 H

(L)

Examiner Only	
Marks	Remark

6 The table below gives information about the salts formed when four metal oxides react with acids.

metal oxide	acid used	formula of cation in salt	formula of anion in salt	formula of salt produced
magnesium oxide	sulfuric acid		SO_4^{2-}	$MgSO_4$
	hydrochloric acid	Na^+		NaCl
copper oxide		Cu^{2+}		$CuSO_4$
calcium oxide	nitric acid		NO_3^-	

(a) Complete the table. [4]

(b) Each of these four reactions can be described as neutralisation. Write an ionic equation, including state symbols, for a neutralisation reaction.

_____ [3]

(c) **(i)** Write a balanced symbol equation for the reaction of magnesium with hydrochloric acid.

_____ [3]

(ii) Describe the test used to identify the gas produced in this reaction.

_____

_____ [2]

H Feb '16

M

Examiner Only	
Marks	Remark

7 Sulfuric acid is a strong acid. It will react with metal carbonates and will neutralise alkalis.

(a) State the pH range for a strong acid.

_____ [1]

(b) **(i)** Write a balanced chemical equation for the reaction between copper carbonate and sulfuric acid.

_____ [3]

(ii) Describe what you would observe during the reaction between copper carbonate and sulfuric acid. Include colour changes in your answer.

_____

_____

_____ [3]

(c) Write a balanced ionic equation for the neutralisation reaction. Include state symbols in your answer.

_____ [3]

C1 H Feb 2012