

Acids, Bases, Salts and Neutralisation[D]

1. Acids are used in many day-to-day applications.

- a. Define the term *acid* in terms of pH: **[2]**

- b. Describe how you could use phenolphthalein to distinguish an acid from an alkali: **[2]**

- c. When universal indicator is added to citric acid solution it goes orange, but when added to hydrochloric acid solution it goes red. State and explain which is the stronger acid: **[2]**

- d. Dilute hydrochloric acid is the active ingredient in many limescale (calcium carbonate) removers. Write a word equation to represent the reaction that would occur: **[2]**

- e. Write a balanced equation, with state symbols, for the reaction in part d. **[3]**

- f. Explain why dilute sulphuric acid would not be an adequate acid to remove limescale from the inside of a water pipe: **[2]**

2. Bronsted-Lowry theory describes the actions of acids, bases and alkalis in terms of hydrogen ions.

a. Explain, using an equation, how nitric acid behaves as an acid: **[2]**

b. Write a balanced equation, with state symbols, to represent the reaction between zinc and nitric acid: **[3]**

c. Explain, using an equation, how magnesium oxide behaves as a base: **[2]**

d. State and explain the colour of blue litmus paper after dipping into:

i. Hydrogen chloride dissolved in water **[2]**

ii. Hydrogen chloride dissolved in methylbenzene **[2]**

e. Derive an ionic equation for the neutralisation of hydrochloric acid by copper(II) carbonate: **[4]**

3. A student wishes to find the concentration of 25cm^3 of an unlabelled solution of hydrochloric acid using a 0.2M solution of potassium hydroxide.

a. Write a balanced equation, with state symbols, for the reaction between hydrochloric acid and potassium hydroxide: **[3]**

b. Write an ionic equation for this reaction: **[3]**

c. Four titrations were carried out.

i. Suggest a suitable indicator and colour change: **[3]**

ii. Fill out the table: **[4]**

	Rough	1	2	3
Initial (cm^3)	0.15	0.30	0.20	2.25
Final (cm^3)	35.10	29.70	29.90	31.55
Titre (cm^3)				

iii. Calculate the average titre using suitable values: **[2]**

iv. Calculate the concentration of the hydrochloric acid solution: **[3]**

Acids, Bases, Salts and Neutralisation[D]

1. Acids are used in many day-to-day applications.

a. Define the term *acid* in terms of pH: [2]

a solution [1] with pH less than 7 [1]

b. Describe how you could use phenolphthalein to distinguish an acid from an alkali: [2]

goes colourless in acid [1]

goes pink in alkali [1]

c. When universal indicator is added to citric acid solution it goes orange, but when added to hydrochloric acid solution it goes red. State and explain which is the stronger acid: [2]

orange = pH 3-5 and red = pH 0-2 [1]

so hydrochloric acid is stronger [1]

d. Dilute hydrochloric acid is the active ingredient in many limescale (calcium carbonate) removers. Write a word equation to represent the reaction that would occur: [2]

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

[1] for calcium chloride, [1] for water + carbon dioxide

e. Write a balanced equation, with state symbols, for the reaction in part d. [3]

$2\text{HCl}(\text{aq}) + \text{CaCO}_3(\text{s}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

[formulae, balance, state symbols]

f. Explain why dilute sulphuric acid would not be an adequate acid to remove limescale from the inside of a water pipe: [2]

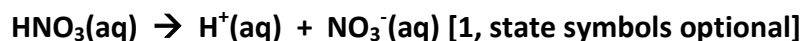
The CaSO_4 formed is not soluble [1]

So it will not be washed away [1]

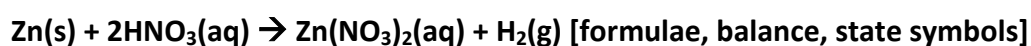
2. Bronsted-Lowry theory describes the actions of acids, bases and alkalis in terms of hydrogen ions.

a. Explain, using an equation, how nitric acid behaves as an acid: [2]

it donates H^+ ions to a solution [1]

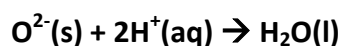


b. Write a balanced equation, with state symbols, to represent the reaction between zinc and nitric acid: [3]



c. Explain, using an equation, how magnesium oxide behaves as a base: [2]

the oxide ion accepts H^+ [1]



d. State and explain the colour of blue litmus paper after dipping into:

i. Hydrogen chloride dissolved in water [2]

red [1]

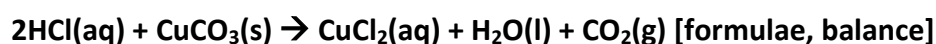
HCl dissociates to give H^+ [1]

ii. Hydrogen chloride dissolved in methylbenzene [2]

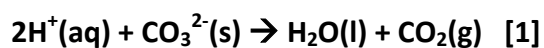
blue [1]

HCl does not dissociate, so no H^+ [1]

e. Derive an ionic equation for the neutralisation of hydrochloric acid by copper(II) carbonate: [4]

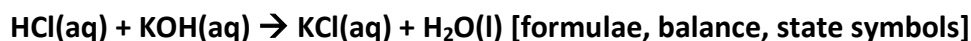


Removal of Cl^- and Cu^{2+} as they are the same on both sides [1]



3. A student wishes to find the concentration of 25cm^3 of an unlabelled solution of hydrochloric acid using a 0.2M solution of potassium hydroxide.

- a. Write a balanced equation, with state symbols, for the reaction between hydrochloric acid and potassium hydroxide: [3]



- b. Write an ionic equation for this reaction: [3]



- c. Four titrations were carried out.

- i. Suggest a suitable indicator and colour change: [3]

EITHER phenolphthalein [1] (colourless [1] to pink [1]) OR methyl orange [1] (red [1] to yellow [1])

- ii. Fill out the table: [4] (each must be to nearest 0.05cm^3)

	Rough	1	2	3
Initial (cm^3)	0.15	0.30	0.20	2.25
Final (cm^3)	35.10	29.70	29.90	31.55
Titre (cm^3)	34.90 [1]	29.40cm^3	29.70cm^3	29.30cm^3

- iii. Calculate the average titre using suitable values: [2]

use values 1 and 3 (within 0.2cm^3 of each other) [1]

average = 29.35cm^3 (must be to 0.05cm^3) [1]

- iv. Calculate the concentration of the hydrochloric acid solution: [3]

Moles KOH = conc * vol = $0.2 * (29.35/1000) = 0.00587\text{mol}$ [1]

Moles HCl = 0.00587mol (1:1 ratio) [1]

Conc HCl = mols / vol = $0.00587 / (25/1000) = 0.235 \text{ mol/dm}^3$ [1] (3sf only)