

# Acids, Bases, Salts and Neutralisation [S]

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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  $25\text{cm}^3$  of an unlabelled solution of hydrochloric acid using a  $0.2\text{M}$  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 ( $\text{cm}^3$ )	0.15	0.30	0.20	2.25
Final ( $\text{cm}^3$ )	35.10	29.70	29.90	31.55
Titre ( $\text{cm}^3$ )				

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

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

# Acids, Bases, Salts and Neutralisation [S]

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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]

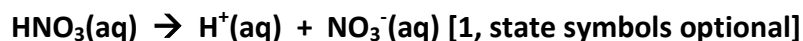
**The  $\text{CaSO}_4$  formed is not soluble [1]**

**So it will not be washed away [1]**

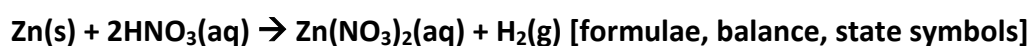
2. Bronsted-Lowry theory describes the actions of acids, bases and alkalis in terms of hydrogen ions.

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

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

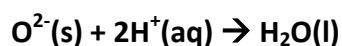


b. Write a balanced equation, with state symbols, to represent the reaction between zinc and nitric acid: [3]



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]**

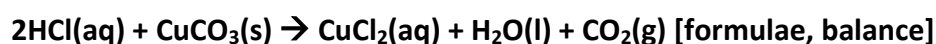
**HCl dissociates to give  $H^+$  [1]**

ii. Hydrogen chloride dissolved in methylbenzene [2]

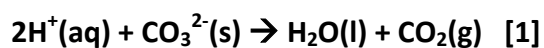
**blue [1]**

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

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

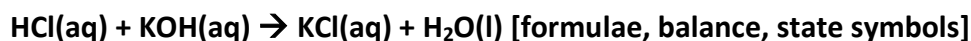


**Removal of  $Cl^-$  and  $Cu^{2+}$  as they are the same on both sides [1]**



3. A student wishes to find the concentration of  $25\text{cm}^3$  of an unlabelled solution of hydrochloric acid using a  $0.2\text{M}$  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  $0.05\text{cm}^3$ )

	Rough	1	2	3
Initial ( $\text{cm}^3$ )	0.15	0.30	0.20	2.25
Final ( $\text{cm}^3$ )	35.10	29.70	29.90	31.55
Titre ( $\text{cm}^3$ )	<b>34.90 [1]</b>	<b>29.40<math>\text{cm}^3</math></b>	<b>29.70<math>\text{cm}^3</math></b>	<b>29.30<math>\text{cm}^3</math></b>

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

**use values 1 and 3 (within  $0.2\text{cm}^3$  of each other) [1]**

**average =  $29.35\text{cm}^3$  (must be to  $0.05\text{cm}^3$ ) [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 =  $0.00587\text{mol}$  (1:1 ratio) [1]**

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