O Level Pure Chemistry Structured

Acids and Bases Test 1.0

Q1

The letters **A**, **B**, **C**, **D**, **E**, **F** and **G** show the oxides of some elements.

A	K_2O
B	CaO
C	Al_2O_3
D	CO
E	NO
F	PbO
G	SiO_2

Use the letters **A**, **B**, **C**, **D**, **E**, **F** and **G** to answer the questions below. The letters can be used once, more than once, or not at all.

(a) Which substance(s) is/are neutral oxides?

.....[1]

(b) Which substance can be used to control the pH of soil?

.....[1]

(c) Which substance(s) is/are involved in the Blast Furnace reactions?

.....[1]

(d) Which two substances can be used to convert naphtha into ethene?

..... and .....[1]

(e) Give the chemical formula for the compound formed from the reaction between **F** and **G**.

.....[1]

(f) Describe a test you could carry out in the laboratory to distinguish aqueous solutions of compounds **A** and **B**.

.....

.....

.....[2]

[total = 7 marks]

Q2

Acid-base titration is often carried out in the laboratory, and the progress of the titration can be monitored using a data logger (pH meter).

The graph below shows the resulting pH curve when 1.0 mol/dm^3 of aqueous sodium hydroxide is added to 10 cm^3 of 2.0 mol/dm^3 of dilute hydrochloric acid.

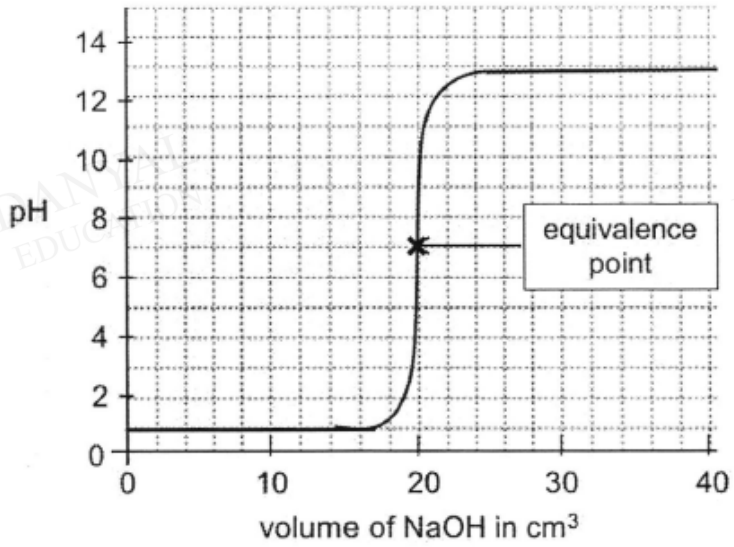


Fig. 3.1

The equivalence point is the point where all the hydrogen ions in the acid have reacted with the hydroxide ions in the alkali.

For the neutralization reaction between aqueous sodium hydroxide and dilute hydrochloric acid, the equivalence point occurs at a pH value of 7.

(a) With the aid of an ionic equation, explain why the equivalence point for a strong acid-strong base titration occurs at a pH value of 7.

.....

.....

.....[2]

(b) Without a pH meter, the progress of the titration can also be monitored using an appropriate indicator, which indicates the end-point of the titration.

Explain why the use of the universal indicator would not be appropriate to monitor the progress of the titration.

.....

.....[1]

(c) When a strong alkali is titrated against a weak acid, the equivalence point occurs at a pH value above 7.

The graph below shows the resulting pH curve when 1.0 mol/dm^3 of aqueous sodium hydroxide is added to 10 cm^3 of 2.0 mol/dm^3 of dilute ethanoic acid.

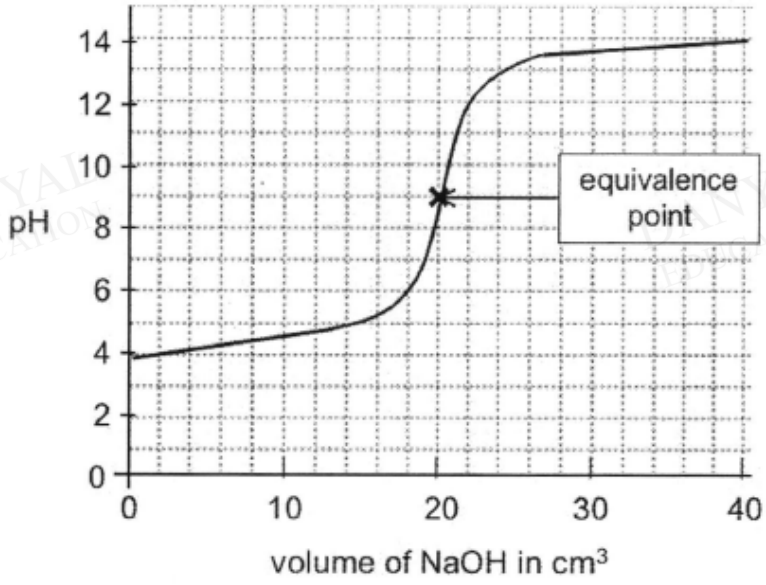


Fig. 3.2

(i) Write the chemical equation for the reaction between aqueous sodium hydroxide and dilute ethanoic acid. State symbols are not required.

.....[1]

(ii) Explain why, in both titration experiments, the equivalence point occurs when 20.0 cm^3 of 1.0 mol/dm^3 aqueous sodium hydroxide is added.

.....

.....

.....

.....[2]

Q3

The table below shows the time taken for the same mass of zinc to react completely with sulfuric acid of various concentrations at room temperature and pressure.

concentration (mol/dm^3)	0.5	1.0	2.0	4.0
time taken (s)	450	45	22	5

(b) Suggest a reason why very little hydrogen gas is produced when the concentration of sulfuric acid used is increased to 10.0 mol/dm^3.

.....

.....

..... [2]

(c) A student repeated the above experiments using calcium while keeping all the other conditions the same. However, it was observed that the reaction stopped shortly. Explain why.

.....

..... [1]

Q4

Tartaric acid is an organic acid extracted from grape juice. Its structure is shown in Fig. 2.1.

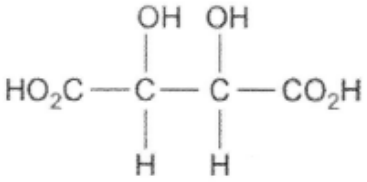


Fig. 2.1

(a) Tartaric acid is an example of a weak acid.

Explain what is meant by a *weak acid*.

.....

.....[1]

(b) Describe a simple test to show that tartaric acid is a weak acid.

.....

.....

.....

.....[2]

(c) A solution of tartaric acid was titrated with 0.100 mol/dm^3 potassium hydroxide. Potassium tartrate and water are the products obtained.

$$C_2H_2(OH)_2(CO_2H)_2 + 2KOH \rightarrow C_2H_2(OH)_2(CO_2K)_2 + 2H_2O$$

(i) 6.00 cm^3 of aqueous potassium hydroxide was required to neutralise 20.0 cm^3 of tartaric acid.

Calculate the concentration, in mol/dm^3, of the tartaric acid solution.

[2]

(ii) Describe how a dry solid sample of the salt produced could be obtained from the products of the reaction.

.....

.....

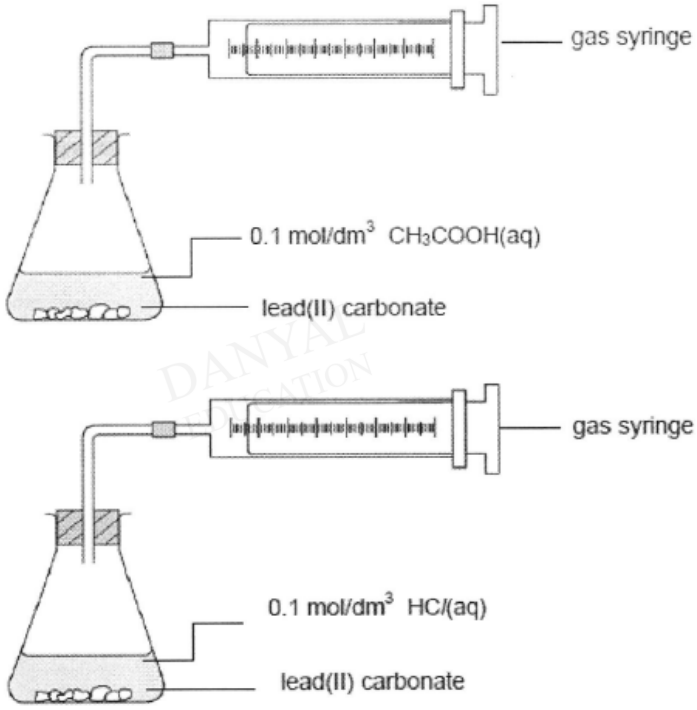
.....

.....[2]

[Total: 7]

Q5

A student conducted an experiment using hydrochloric acid and ethanoic acid to prepare two different salts. The experimental setup used is shown below.



(a) Hydrochloric acid is a strong acid, ethanoic acid is a weak acid.
Describe a **simple** test to show which is the strong acid and which is the weak acid.

_____

_____

_____ [2]

(b) State the chemical formulae of the **two** salts formed from the above experiment

_____ [2]

(c) The student recorded down the following observations.

"*Slower effervescence is observed with ethanoic acid at the beginning of the experiment but the gas syringe is pushed further away from its initial position at the end of the experiment.*"

Explain the above observations made.

_____

_____

_____

_____

_____ [4]

(d) An exothermic change occurred in both reactions mentioned above.
Define *exothermic change*.

_____

_____ [1]

Answers

Acids and Bases Test 1.0

Q1

(a)	**D** and **E**	[1]
(b)	**B**	[1]
(c)	**B**, **D** and **G**	[1]
(d)	**C** and **G**	[1]
(e)	$PbSiO_3$	[1]
(f)	Add aqueous sodium hydroxide to separate solutions of **A** and **B**. [1] **A** will not produce any ppt./no visible change while **B** will give a white ppt. that is insoluble in excess sodium hydroxide. [1] OR Add dilute sulfuric acid / any aqueous sulfate salt to separate solutions of **A** and **B**. [1] **A** will not produce any ppt./no visible change while **B** will give a white ppt.. [1] (answers that do not specify aqueous sulfate salts will not be awarded the first mark) OR Bubble carbon dioxide gas into separate solutions of **A** and **B**. [1] **A** will have no visible change while **B** will give a white ppt.. [1]	[2]

Q2

(a)	H^+ (aq) + OH^- (aq) □ H_2O (l) [1] All the hydrogen ions in the acid have reacted with all the hydroxide ions in the alkali / the acid reacts with the alkali to produce a neutral salt and water only. [1]	[2]
(b)	Universal indicator shows a gradient of colours / does not have a distinct colour change at particular pH values.	[1]
(c)(i)	$CH_3COOH + NaOH$ □ $CH_3COONa + H_2O$	[1]
(c)(ii)	Since both ethanoic acid and hydrochloric acid are monobasic acids / same number of moles of H^+ ions [1] the same number of moles of each acid will require the same volume of sodium hydroxide to neutralize, given that the concentration is the same / same number of moles of sodium hydroxide to neutralize (*concept that the mole ratio of acid : alkali is 1:1*). [1]	[2]

Q3

(b)	When concentration of sulfuric acid is increased to 10 mol/dm^3, there is very little water present. Most of the acid molecules do not dissociate to form H^+ ions.	1 1
(c)	Insoluble calcium sulfate is formed on the calcium carbonate. This prevent the remaining calcium from reacting.	1

Q4

(a)	An acid which dissociates/ionises partially in water to produce H^+ ions;	[1]
(b)	Add a few drops of universal indicator to a sample of the acid; Green universal indicator/colourless solution will turn orange/yellow; A: use a pH meter to measure pH of tartaric acid, methyl orange (1m) R: red	[1] [1]
(c)(i)	No. of mole of KOH = 0.100 x (6/1000) = 0.0006 mol; No. of mole of tartaric acid = 0.0006/2 = 0.0003 mol Conc. of tartaric acid = 0.0003 x (1000/20) = 0.015 mol/dm^3;	[1] [1]
(c)(ii)	Heat the salt solution obtained to saturation; Cool and allow crystallisation to take place; Filter to obtain the crystals; Wash with distilled water, dry between pieces of filter paper;	[1] for 2 points in logical sequence

Q5

(a) Measure pH of the acid samples with a pH meter, [1] [2]
if the acid gives a lower pH reading such as 1 or 2, it is a strong acid while acid that gives a higher pH reading such as 3 or 4 is a weak acid. [1]

OR

Add two or three drops of Universal indicator into each acid sample separately. If the UI produced a red colour, the acid is a strong acid. If the UI produced a yellow or orange colour, the acid is a weak acid.

(b) $(CH_3COO)_2Pb$ [1]
$PbCl_2$ [1]

(c) Ethanoic acid dissociate partially in aqueous solution to produce H^+ ions [1]
Ethanoic acid produces a lower initial concentration of H^+ ions in aqueous solution than hydrochloric acid [1]
Hence produces a slower initial rate of reaction.
[Accept RA for hydrochloric acid]

Lead(II) carbonate reacts with hydrochloric acid to form **insoluble** lead(II) chloride [1]
which coats around lead(II) carbonate and prevents it from further reaction with acid. [1]
gives a low yield of carbon dioxide gas.
[Accept RA for ethanoic acid] [4]

(d) An exothermic change refers to a chemical reaction in which energy is given out to the surroundings [1]