

ACIDS AND BASES PRACTISE QUESTIONS

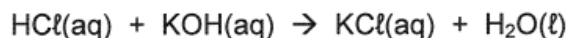
2006 Standard Grade Paper 2 Q 7

QUESTION 7 (Start on a new page)

A learner is provided with 50 cm³ of dilute hydrochloric acid with a concentration of 0,35 mol.dm⁻³.

7.1 What is meant by a **dilute acid solution**? (2)

7.2 The reaction between hydrochloric acid and potassium hydroxide is given by the following balanced equation:



7.2.1 Consider the following indicators:

Indicator	pH range
Methyl orange	3,1 – 4,4
Phenol red	6,8 – 8,4
Alizarin yellow	10,1 – 12,0

Which indicator is the most suitable for use in this reaction? (2)

7.2.2 Give a reason for your choice in QUESTION 7.2.1. (2)

7.2.3 Calculate the number of moles of hydrogen ions present in the hydrochloric acid solution. (3)

7.2.4 If the 50cm³ hydrochloric acid is neutralised by 70cm³ potassium hydroxide solution, calculate the concentration of the potassium hydroxide solution. (4)

[13]

2008 June Higher Grade Paper 2 Q 7

- 7.1 A certain species of fish cannot survive in water having a pH less than 5,5. In a river the hydrogen ion concentration was measured to be $3,2 \times 10^{-5} \text{ mol.dm}^{-3}$.

Will this species of fish survive in this river? Show clearly how you arrived at the answer.

(5)

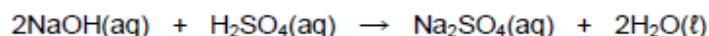
- 7.2 A certain compound has ammonium chloride as the main ingredient. A group of learners investigated the amount of ammonium chloride present in a sample of the compound. The learners added 100 cm^3 of a $1,0 \text{ mol.dm}^{-3}$ solution of sodium hydroxide to the sample in a flask.

7.2.1 Calculate the amount (in moles) of sodium hydroxide.

(3)

This mixture was warmed to remove the ammonia formed. The excess sodium hydroxide was then neutralised through a titration by 45 cm^3 of a $0,3 \text{ mol.dm}^{-3}$ sulphuric acid solution.

The relevant equations are:



Calculate the following:

- 7.2.2 The number of moles of sodium hydroxide that was neutralised by the sulphuric acid solution

(3)

- 7.2.3 The mass (in moles) of ammonium chloride in the sample

(7)

The following indicators are available for the titration.

Indicator	pH range
Methyl orange	3,2 – 4,4
Bromothymol blue	6,0 – 7,6
Phenolphthalein	8,2 – 10,0

- 7.2.4 Select from the list and write down the best indicator to use for this investigation.

(2)

- 7.2.5 Give a reason for your choice in QUESTION 7.2.4.

(2)

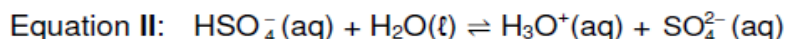
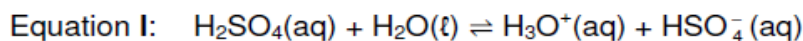
[22]

2014 Free State Preliminary Paper 2 Q 7

- 7.1 Sulphuric acid is a strong acid and an example of an acid which can donate two protons per molecule.

7.1.1 Write down one word or term for the underlined phrase. (1)

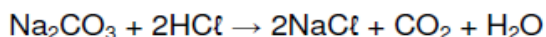
The equations below represent the ionisation of sulphuric acid.



7.1.2 Write down the FORMULA of a species that acts as ampholyte in the above reactions. (1)

7.1.3 Write down the NAME of the conjugate base of the hydrogen sulphate ion. (1)

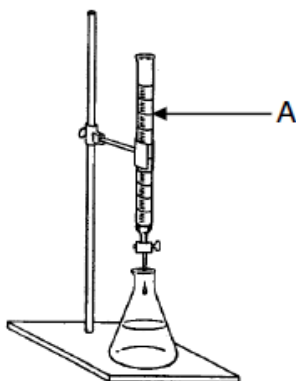
- 7.2 A learner adds an impure sample of sodium carbonate into a flask containing 50 cm^3 of a hydrochloric acid solution with a $\text{pH} = 0$. The hydrochloric acid is in excess. The balanced equation for the reaction that takes place is:



7.2.1 Calculate the number of moles of hydrochloric acid present in the flask. (5)

7.2.2 Write down a balanced equation that explains why a sodium carbonate solution has a pH greater than 7. (3)

7.2.3 The apparatus illustrated below is used during a titration to determine the mass of sodium carbonate present in the sample.

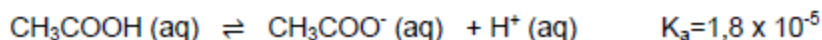


Write down the name of the apparatus labelled A. (1)

- 7.2.4 During the titration, the excess hydrochloric acid is neutralised by 30 cm^3 of a $0,4 \text{ mol} \cdot \text{dm}^{-3}$ sodium hydroxide solution. Calculate the mass of sodium carbonate in the sample. (6)
- [18]**

2014 Gauteng Preliminary Paper 2 Q 6

You are given the following ionisation reaction of ethanoic acid in water:



- 6.1 What does the ionisation constant indicate about the strength of the acid? (1)
- 6.2 What is meant by a *concentrated acid*? (2)
- 6.3 H_2PO_4^- is an ampholyte.
Write an equation to indicate its role as a base. (2)
- 6.4 Write down a conjugate acid/base pair from your equation in QUESTION 6.3. (1)
- 6.5 Milk of Magnesia has been used over the ages to relieve stomach ailments caused by excess stomach acid. The active ingredient in Milk of Magnesia is magnesium hydroxide (Mg(OH)_2).

A group of learners prepare a solution of magnesium hydroxide.

- 6.5.1 What mass of Mg(OH)_2 must be dissolved in distilled water to prepare 500 cm^3 of a solution with a concentration of $0,20 \text{ mol}\cdot\text{dm}^{-3}$? (5)
- 6.5.2 What will the concentration of the hydroxide ions in the solution be? Assume 100% dissociation of magnesium hydroxide in water. (2)
- 6.5.3 The pH of any medicine safe for human consumption must lie between $\text{pH} = 4$ and $\text{pH} = 9$.

Will this solution that the learners prepare be safe for human consumption? Show all calculations. (5)
- 6.6 The learners now check the concentration of their solution that they made. They run a titration using hydrochloric acid of concentration $0,1 \text{ mol}\cdot\text{dm}^{-3}$. They transfer 25 cm^3 of the magnesium hydroxide solution into a conical flask.

The balanced chemical equation for this reaction is:



Determine what volume of HCl will be needed to fully neutralise the Milk of Magnesia if the concentration is actually $0,2 \text{ mol}\cdot\text{dm}^{-3}$. (4)

[22]

2019 Kwazulu Natal Preliminary Paper 2 Q 7

- 7.1 A **dilute solution of sulphuric acid** has a concentration $0,012 \text{ mol.dm}^{-3}$
- 7.1.1 Define an acid according to Arrhenius theory. (2)
- 7.1.2 Is the above solution of sulphuric acid a strong or weak acid? Explain the answer. (3)
- 7.2 A learner adds 24 cm^3 of a solution of sulphuric acid of concentration $0,25 \text{ mol.dm}^{-3}$ to an unknown volume, $X \text{ cm}^3$, of a solution of sodium hydroxide of concentration $0,15 \text{ mol.dm}^{-3}$. The balanced equation for the reaction is:
- $$\text{H}_2\text{SO}_4 + 2\text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$$
- The pH of the resulting solution is 0,65.
- 7.2.1 Calculate the concentration of the sulphuric acid solution after it has reacted with the sodium hydroxide solution. (4)
- 7.2.2 Calculate the initial volume(X) of the sodium hydroxide solution. Assume that the volume of the solution after the reaction is $(X + 24) \text{ cm}^3$. (7)
- [16]

2019 Gauteng Preliminary Paper 1 Q 9

- 9.1 Washing soda contains sodium carbonate (Na_2CO_3) as its most important constituent.
- Learners used 5,13 g of the washing soda crystals to prepare a 250 cm^3 solution in distilled water. They titrated 25 cm^3 of the sodium carbonate solution with 36 cm^3 of a $0,05 \text{ mol.dm}^{-3} \text{ H}_2\text{SO}_4$ solution to neutralise the solution.
- The balanced equation for the reaction is:
- $$\text{Na}_2\text{CO}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$
- 9.1.1 Define an *ampholyte*. (2)
- 9.1.2 Identify which ONE of the compounds in the equation above CAN act as an ampholyte. (1)
- 9.1.3 Calculate the number of moles of sulphuric acid that reacted with the sodium carbonate. (3)
- 9.1.4 Calculate the mass of the sodium carbonate in the washing soda that was used and neutralised during the titration. (4)
- 9.1.5 Calculate the percentage purity of the washing soda sample. (3)
- 9.2 When CO_3^{2-} ions are added to water, the concentration of the hydroxide ions present in the water increases.
- Write down a balanced equation for this reaction between CO_3^{2-} and H_2O . (2)
- [15]

2020 Eastern Cape Preliminary Paper 1 Q 7

- 7.1 Study the following reactions which show the step-by-step ionisation reaction of phosphoric acid (H_3PO_4).



7.1.1 Define an *acid* according to Lowry-Bronsted model. (2)

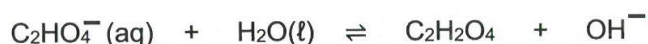
7.1.2 Write down the formula of the substance that acts as an ampholyte in reaction I and II. (1)

7.1.3 Give a reason for the answer in QUESTION 7.1.2 above. (2)

7.1.4 Which substance, H_2PO_4^- or HPO_4^{2-} , will have a HIGHER K_b value?

Give a reason for your answer. (3)

- 7.2 Consider the hydrolysis of the ion C_2HO_4^- represented by the balanced equation below.



7.2.1 Define the term *hydrolysis*. (2)

7.2.2 Write down the conjugate base of $\text{C}_2\text{H}_2\text{O}_4$. (2)

7.2.3 Give a reason by referring to substance(s) in the equation why the hydrolysis of C_2HO_4^- produces an ALKALINE solution? (2)

- 7.3 A group of learners perform a titration to determine x number of moles of water of crystallisation in hydrated oxalic acid ($\text{C}_2\text{O}_4\text{H}_2 \cdot x \text{H}_2\text{O}$).

They first prepared a solution of hydrated oxalic acid, by adding 7,56 grams of hydrated oxalic acid to water and made a volume of 250 cm^3 solution.

During a titration 25 cm^3 of the solution of hydrated oxalic acid is neutralised by exactly 24 cm^3 of a $0,5 \text{ mol} \cdot \text{dm}^{-3}$ solution of sodium hydroxide according to the balanced equation:



(Water of crystallisation does not react with the base.)

7.3.1 Define a *strong* base. (2)

7.3.2 Calculate the pH of the $0,5 \text{ mol} \cdot \text{dm}^{-3}$ sodium hydroxide solution. (5)

7.3.3 Determine the value of x by calculation. (7)

[28]

2020 North West Preliminary Paper 2 Q 7

- 7.1 Hydrochloric acid (HCl), with a concentration of $0,01 \text{ mol}\cdot\text{dm}^{-3}$, is a strong monoprotic acid. Another monoprotic acid HX has a pH of 3.

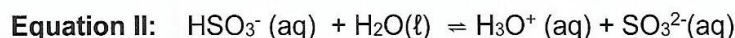
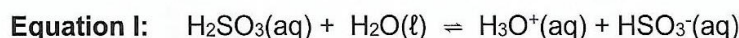
7.1.1. Define the term *strong acid*. (2)

7.1.2 Calculate the concentration of the hydrogen ions in the HX solution. (3)

7.1.3 Is the acid similar in strength to HCl? (Answer YES or NO). (1)

7.1.4 Give a reason to QUESTION 7.1.3 above. (2)

- 7.2 Sulphurous acid reacts with water in two steps as represented by the equations below.



7.2.1 Define the term *ampholyte*. (2)

7.2.2 Write down the FORMULA of a species that acts as an ampholyte in the above reactions. (1)

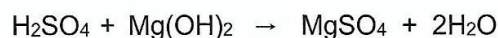
7.2.3 Write down the NAME of the conjugate base of hydrogen sulphite ion. (1)

- 7.3 Five grams (5 g) of an impure sample of sodium carbonate is added to 100 ml of a $0,2 \text{ mol}\cdot\text{dm}^{-3}$ solution of sulphuric acid. The acid is in excess. The equation for the reaction is given as follows:



7.3.1 Calculate the number of moles of sulphuric acid. (3)

The excess acid neutralizes 20 cm^3 of a solution of $0,2 \text{ mol}\cdot\text{dm}^{-3}$ of magnesium hydroxide according to the following equation:

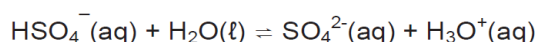


7.3.2 Calculate the mass of the impurity in the sodium carbonate sample. (7)
[22]

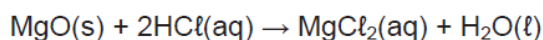
2021 Mpumalanga June Paper 2 Q 8

- 8.1 A learner prepares a sulphuric acid (H_2SO_4) solution with a concentration of $0,25 \text{ mol}\cdot\text{dm}^{-3}$.
- 8.1.1 Give a reason why sulphuric acid is referred to as a diprotic acid. (2)
- 8.1.2 Determine the pH of this solution. (4)
- 8.1.3 The learner takes 20 cm^3 of this solution and dilutes it to a solution with a concentration of $0,1 \text{ mol}\cdot\text{dm}^{-3}$. Calculate the volume of water that was added to the initial 20 cm^3 solution. (4)

- 8.2 A few crystals of ammonium chloride (NH_4Cl) are added to water in a test tube. The pH of the solution is less than 7.
- Explain with the aid of a balanced equation why the pH is less than 7. (3)
- 8.3 The hydrogen sulphate ion (HSO_4^-) can act as both an acid and a base. It reacts with water according to the following balanced equation:

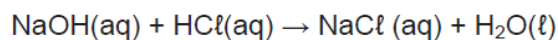


- 8.3.1 Write down ONE word for a substance that can act as both an acid and a base. (1)
- 8.3.2 Write down the FORMULAE of two bases in the above reaction. (2)
- 8.4 A small amount of NaOH is added to pure water at a temperatures of 25°C . How will this affect the:
- (Choose between: INCREASES, DECREASES or NO CHANGE.)
- 8.4.1 K_w (1)
- 8.4.2 $[\text{H}_3\text{O}^+]$ (1)
- 8.5 A learner wants to determine the percentage magnesium oxide in a health tablet. She dissolves the tablet in 50 cm^3 of $0,8 \text{ mol}\cdot\text{dm}^{-3}$ hydrochloric acid solution. The balanced equation for the reaction is:



- 8.5.1 Calculate the number of moles of acid present in 50 cm^3 of a $0,8 \text{ mol}\cdot\text{dm}^{-3}$ hydrochloric acid solution. (3)

Not all of the hydrochloric acid reacts. She titrates the excess hydrochloric acid with a sodium hydroxide solution. It takes 20 cm^3 of the $0,5 \text{ mol}\cdot\text{dm}^{-3}$ of sodium hydroxide solution to neutralise the excess hydrochloric acid. The hydrochloric acid and sodium hydroxide react as shown in the balanced equation below.



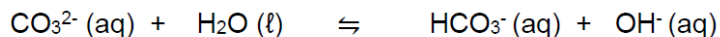
- 8.5.2 The original mass of the tablet is 0,96 g. Calculate the percentage of magnesium oxide in the tablet. (8)

[29]

2021 Eastern Cape June Paper 2 Q 7

- 7.1 Sodium carbonate ionises in water into sodium ions (Na^+) and carbonate ions (CO_3^{2-}).

Carbonate ions in solution undergo hydrolysis according to the balanced equation:



- 7.1.1 Define *hydrolysis*. (2)
- 7.1.2 Give a reason why a solution of sodium carbonate in water is alkaline by referring to substance(s) in the equation above. (2)
- 7.1.3 Write down the FORMULAE of the TWO acids in the equation. (2)
- 7.1.4 Give a reason why HCO_3^- can act as an ampholyte. (2)
- 7.2 A solution of a strong diprotic acid **X** has $\text{pH} = 1$.

- 7.2.1 Define an *acid* according to the Lowry-Bronsted theory. (2)
- 7.2.2 Calculate the concentration of acid **X**. (4)

A solution of acid **X** of concentration $0,049 \text{ mol}\cdot\text{dm}^{-3}$ is diluted by adding 15 cm^3 of the acid to water to produce 90 cm^3 of a dilute standard solution.

- 7.2.3 Explain the meaning of the term *standard solution*. (2)

The DILUTE solution of acid **X** is titrated with a solution of potassium hydroxide.

The following list of indicators are available for the titration.

Indicator	pH-range
Methyl orange	3,1 – 4,4
Bromothymol blue	6,0 – 7,6
Phenolphthalein	8,3 – 10,0

- 7.2.4 Which ONE of the indicators is the most suitable for this titration? (7)
Explain the answer. (3)

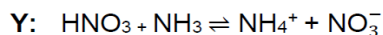
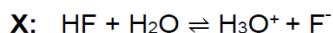
During the titration 25 cm^3 of the DILUTE acid **X** solution neutralises exactly $28,5 \text{ cm}^3$ of a potassium hydroxide solution.

- 7.2.5 Calculate the concentration of the potassium hydroxide solution. (7)
[26]

2022 Gauteng Preliminary Paper 2 Q 7

7.1 Define the term *acid* according to the Arrhenius theory. (2)

7.2 Consider the following acid-base reactions.



7.2.1 From reactions **X** and **Y** identify the reaction that illustrates the Arrhenius theory. (1)

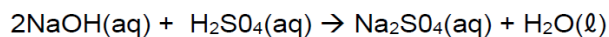
7.2.2 Write down a balanced equation for the hydrolysis of NH_4^+ ions. (3)

7.2.3 Will the resultant solution from QUESTION 7.2.2 be acidic, basic or neutral? Give a reason for your answer. (2)

7.3 A sodium hydroxide solution is prepared by dissolving 4 g of sodium hydroxide in water to make a 500 cm³ solution.

7.3.1 Calculate the concentration of the sodium hydroxide solution. (3)

7.3.2 During a titration, 12,5 cm³ of sodium hydroxide solution neutralises 25 cm³ of a sulphuric acid solution according to the following balanced chemical equation:

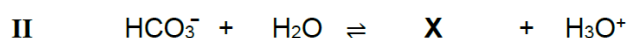
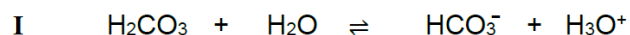


Calculate the pH of the H_2SO_4 solution. (7)
[18]

7.1.3 Which ACID (CH_3COOH or H_2CO_3) is stronger?

Explain the answer. (3)

H_2CO_3 undergoes ionisation in a TWO step process as shown below:



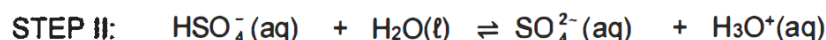
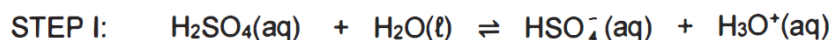
Write down the formula of the substance(s) that:

7.1.4 Are bases in reaction **I** (2)

7.1.5 Is represented by **X** in reaction **II** (1)

2023 KwaZulu Natal June Paper 2 Q 7

7.1 Sulphuric acid, H_2SO_4 , ionizes in water in TWO steps as follows:



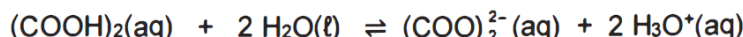
7.1.1 Define an acid in terms of the Arrhenius theory. (2)

7.1.2 Write down the NAME or FORMULA of the substance that acts as an ampholyte in the above equations. Give a reason for the answer. (2)

7.2 The K_a value for TWO acids are as follows:

NAME OF ACID	FORMULA OF ACID	K_a VALUE
Oxalic Acid	$(\text{COOH})_2$	$5,6 \times 10^{-2}$
Carbonic Acid	H_2CO_3	$4,3 \times 10^{-2}$

7.2.1 Oxalic acid ionizes in water according to the following balanced equation:



Write down the formula of the TWO BASES in this reaction. (2)

7.2.2 Which ONE, oxalic acid or carbonic acid, will have a higher conductivity? Explain the answer by referring to the information in the table. (3)

7.3 Water is added to a $0,01 \text{ mol.dm}^{-3}$ solution of hydrochloric acid. How does the addition of the water affect each of the following? (Choose from: INCREASES, DECREASES or REMAINS THE SAME).

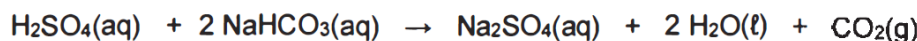
7.3.1 The strength of the solution of the hydrochloric acid. (1)

7.3.2 The concentration of the solution of the hydrochloric acid. Give a reason for the answer. (2)

7.4 A solution of sodium hydrogen carbonate, (NaHCO_3) of volume 250 cm^3 , is prepared by dissolving $x \text{ g}$ of sodium hydrogen carbonate in sufficient distilled water in a volumetric flask.

20 cm^3 of the prepared sodium hydrogen carbonate solution neutralises $12,58 \text{ cm}^3$ of a sulphuric acid (H_2SO_4) solution of $0,29 \text{ mol.dm}^{-3}$.

The balanced equation for the reaction is:



7.4.1 Define the equivalence point of a titration. (2)

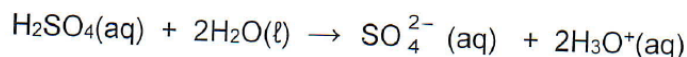
7.4.2 Calculate the concentration of the NaHCO_3 solution that neutralised the H_2SO_4 solution. (4)

7.4.3 Calculate x , the mass of sodium hydrogen carbonate used to prepare the initial solution of sodium hydrogen carbonate. (4)

[22]

2023 North West Preliminary Paper 2 Q 7

- 7.1 Sulphuric acid, $\text{H}_2\text{SO}_4(\text{aq})$, of concentration $0,4 \text{ mol}\cdot\text{dm}^{-3}$ ionises completely in water according to the following balanced equation:



- 7.1.1 Write down the term for the underlined phrase. (1)

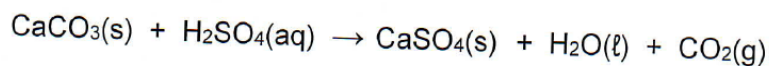
- 7.1.2 Is Ionisation constant i.e. K_a value in above reaction HIGH or LOW? (1)

- 7.1.3 Is sulphuric acid MONOPROTIC ACID or DIPROTIC ACID?

Give a reason for the answer. (2)

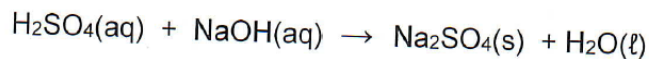
- 7.1.4 Calculate the pH of sulphuric acid. (3)

- 7.2 A learner adds a sample of calcium carbonate to 50 cm^3 of EXCESS sulphuric acid of concentration $0,4 \text{ mol}\cdot\text{dm}^{-3}$. The balanced equation for the reaction that takes place is:



- 7.2.1 Calculate the INITIAL number of moles of sulphuric acid. (3)

The excess H_2SO_4 is now neutralised by 28 cm^3 of a $0,5 \text{ mol}\cdot\text{dm}^{-3}$ sodium hydroxide solution. The balanced equation for the reaction is:



- 7.2.2 Calculate the mass of calcium carbonate in this sample. (7)

[17]