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Acids and Bases

Classwork/Homework 1

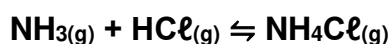
Date: _____

1. Give three properties of acids.
2. Give three properties of bases.

Classwork/Homework 2

Date: _____

1. Define an acid and base according to Bronsted –Lowry theory,
2. Define an acid and base according Arrhenius theory.
3. The following reaction is a Lowry-Bronsted acid base reaction.



The reason the reaction is classified as an acid base reaction is that ...

- A NH_3 accepts a proton.
- B HCl accepts a proton.
- C NH_3 donates a proton.
- D HCl donates an electron

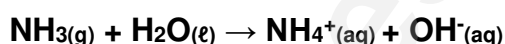
Classwork/Homework 3

Date: _____

1. Give the conjugate acid-base pairs in the following reactions.



2. Consider the following reaction:



An example of a conjugate acid-base pair for this reaction is

- | | | | |
|----|--|---|-----------------------------------|
| A. | NH_3 and H_2O | B | NH_3 and OH^- |
| B. | NH_3 and NH_4^+ | D | NH_4^+ and OH^- |

Classwork/Homework 4

Date: _____

1. Distinguish between strong, concentrated acids.
2. Distinguish between weak, diluted acids.
3. $0,1 \text{ mol.dm}^{-3}$ solutions of two monoprotic acids, A and B, are prepared. The K_A values for A and B are respectively $4,2 \times 10^{-4}$ and $5,1 \times 10^{-5}$.
 - a) Which acid is stronger? (A or B)
 - b) Which acid solution will have the lowest pH?
 - c) Which acid solution will have the lowest hydroxide ion concentration?

Classwork/Homework 5

Date: _____

1. Give a reason why sulphuric acid is referred to as a *diprotic acid*.

Define the following terms:

2. Amphiprotic substance
3. Auto-ionization
4. K_w

Classwork/Homework 6

Date: _____

1. State the meaning of the term *pH scale*.
2. 100 cm³ water is added to 50 cm³ of a 0,2 mol.dm⁻³ HCl-solution. Calculate the concentration of final solution.
3. What volume of water must be added to 20 cm³ of a solution with pH 3, to change the pH to 4.

Classwork/Homework 7

Date: _____

1. The same number of moles of two monoprotic acids, P and Q, is dissolved in the same amount of water. The following concentrations are measured in the resulting solutions:

P $[\text{OH}^-] = 2 \times 10^{-11} \text{ mol.dm}^{-3}$

Q $[\text{OH}^-] = 3 \times 10^{-12} \text{ mol.dm}^{-3}$

- a) Which acid, P or Q, is stronger? Explain.
- b) Which solution will have the lowest pH?

2. The pH of a 0,2 mol.dm⁻³ solution of HA is 5.

- a) Calculate the concentration of the hydronium ions in the solution.
- b) Is HA a strong acid? Explain.

3. An unknown amount of NaOH is dissolved in 250 cm³ water and the solution has a pH of 12,2.

- a) Calculate the concentration of the hydronium ions in the solution.
- b) Calculate the mass of NaOH that is dissolved in the water.

1. Complete the table:

INDICATOR	pH RANGE	COLOUR IN ACID	COLOUR IN BASE
Methyl orange			
Bromothymol blue			
Phenolphthalein			

2. Explain what is meant by the following concepts:

2.1 Neutralisation reaction.

2.2 Hydrolysis

2.3 Endpoint of titration

1.1 Nitric acid (HNO_3), an important acid used in industry, is a strong acid.

1.1.1 Give a reason why nitric acid is classified as a strong acid. (1)

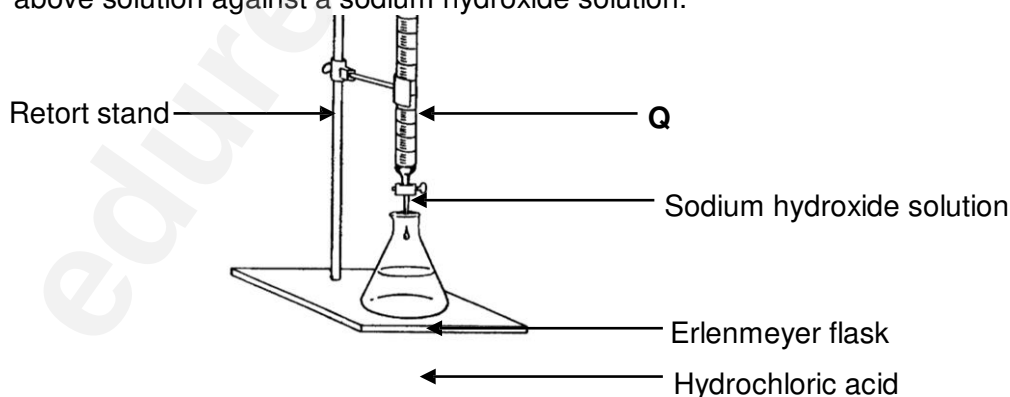
1.1.2 Write down the NAME or FORMULA of the conjugate base of nitric acid. (1)

1.1.3 Calculate the pH of a $0,3 \text{ mol} \cdot \text{dm}^{-3}$ nitric acid solution. (3)

1.2 A laboratory technician wants to determine the percentage purity of magnesium oxide. He dissolves a $4,5 \text{ g}$ sample of the magnesium oxide in 100 cm^3 hydrochloric acid of concentration $2 \text{ mol} \cdot \text{dm}^{-3}$.

1.2.1 Calculate the number of moles of hydrochloric acid added to the magnesium oxide. (3)

He then uses the apparatus below to titrate the EXCESS hydrochloric acid in the above solution against a sodium hydroxide solution.



1.2.2 Write down the name of apparatus Q in the above diagram. (1)

1.2.3 The following indicators are available for the titration:

INDICATOR	pH RANGE
A	3,1 – 4,4
B	6,0 – 7,6
C	8,3 – 10,0

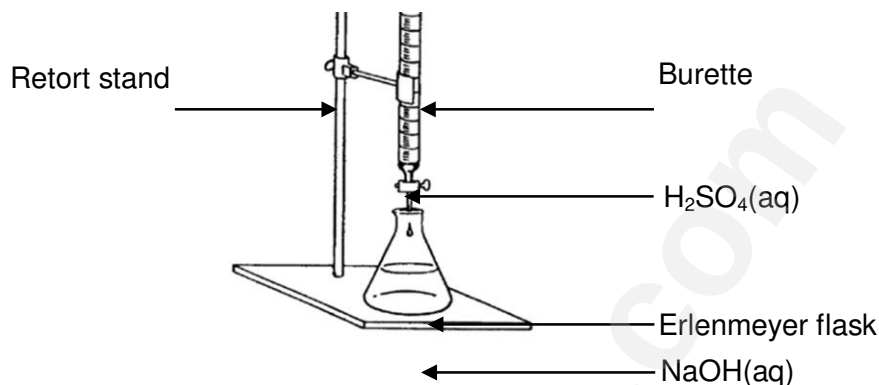
When ONE of the above indicators (A, B or C) is most suitable to indicate the exact endpoint in this titration? Give a reason for the answer. (3)

- 1.2.4 During the titration, the technician uses distilled water to wash any sodium hydroxide spilled against the sides of the Erlenmeyer flask into the solution. Give a reason why the addition of distilled water to the Erlenmeyer flask will not influence the results. (1)
- 1.2.5 At the endpoint of the titration he finds that 21 cm³ of a 0,2 mol dm⁻³ sodium hydroxide solution has neutralised the EXCESS hydrochloric acid. Calculate the number of moles of hydrochloric acid in excess. (3)
- 1.2.6 The balanced equation for the reaction between hydrochloric acid and magnesium oxide is: $\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$
- Calculate the percentage purity of the magnesium oxide. Assume that only the magnesium oxide in the 4,5 g sample reacted with the acid. (5)
- [21]**

Classwork/Homework 10

Date: _____

The reaction between a sulphuric acid (H_2SO_4) solution and a sodium hydroxide (NaOH) solution is investigated using the apparatus illustrated below.

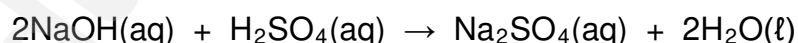


1. Write down the name of the experimental procedure illustrated above. (1)
2. What is the function of the burette? (1)
3. Define an *acid* in terms of the Arrhenius theory. (2)
4. Give a reason why sulphuric acid is regarded as a strong acid. (1)
5. Bromothymol blue is used as indicator. Write down the colour change that will take place in the Erlenmeyer flask on reaching the endpoint of the titration.

Choose from the following:

BLUE TO YELLOW YELLOW TO BLUE GREEN TO YELLOW (1)

During the titration a learner adds 25 cm^3 of NaOH(aq) of concentration $0,1 \text{ mol} \cdot \text{dm}^{-3}$ to an Erlenmeyer flask and titrates this solution with $\text{H}_2\text{SO}_4(\text{aq})$ of concentration $0,1 \text{ mol} \cdot \text{dm}^{-3}$. The balanced equation for the reaction that takes place is:



6. Determine the volume of $\text{H}_2\text{SO}_4(\text{aq})$ which must be added to neutralise the NaOH(aq) in the Erlenmeyer flask completely. (4)
7. If the learner passes the endpoint by adding 5 cm^3 of the same $\text{H}_2\text{SO}_4(\text{aq})$ in excess, calculate the pH of the solution in the flask. (7)

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Classwork/Homework

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Date: _____

Learners perform a titration to standardise a dilute sodium hydroxide (NaOH) solution.

They use standard oxalic acid ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) solution of concentration $0,02 \text{ mol} \cdot \text{dm}^3$.

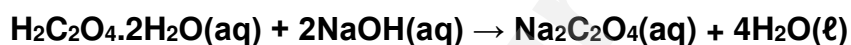
The titration is repeated three times after which the average volume readings are calculated as shown in the table below:

Titration	Volume of oxalic acid solution (cm^3)	Volume NaOH solution (cm^3)
1	25	20,24
2	25	19,80
3	25	19,87
Average	25	19,97

1. What does the term *standard solution* mean? (2)

2. Give a reason why the titration is repeated three times. (1)

3. The balanced equation for the reaction taking place is:



Calculate the number of moles of oxalic acid reacting. (3)

4. The dilute solution of sodium hydroxide used in the titration was obtained by adding 90 cm^3 of water to 10 cm^3 of a sodium hydroxide solution.

Calculate the pH of the sodium hydroxide solution BEFORE dilution. (8)
[14]