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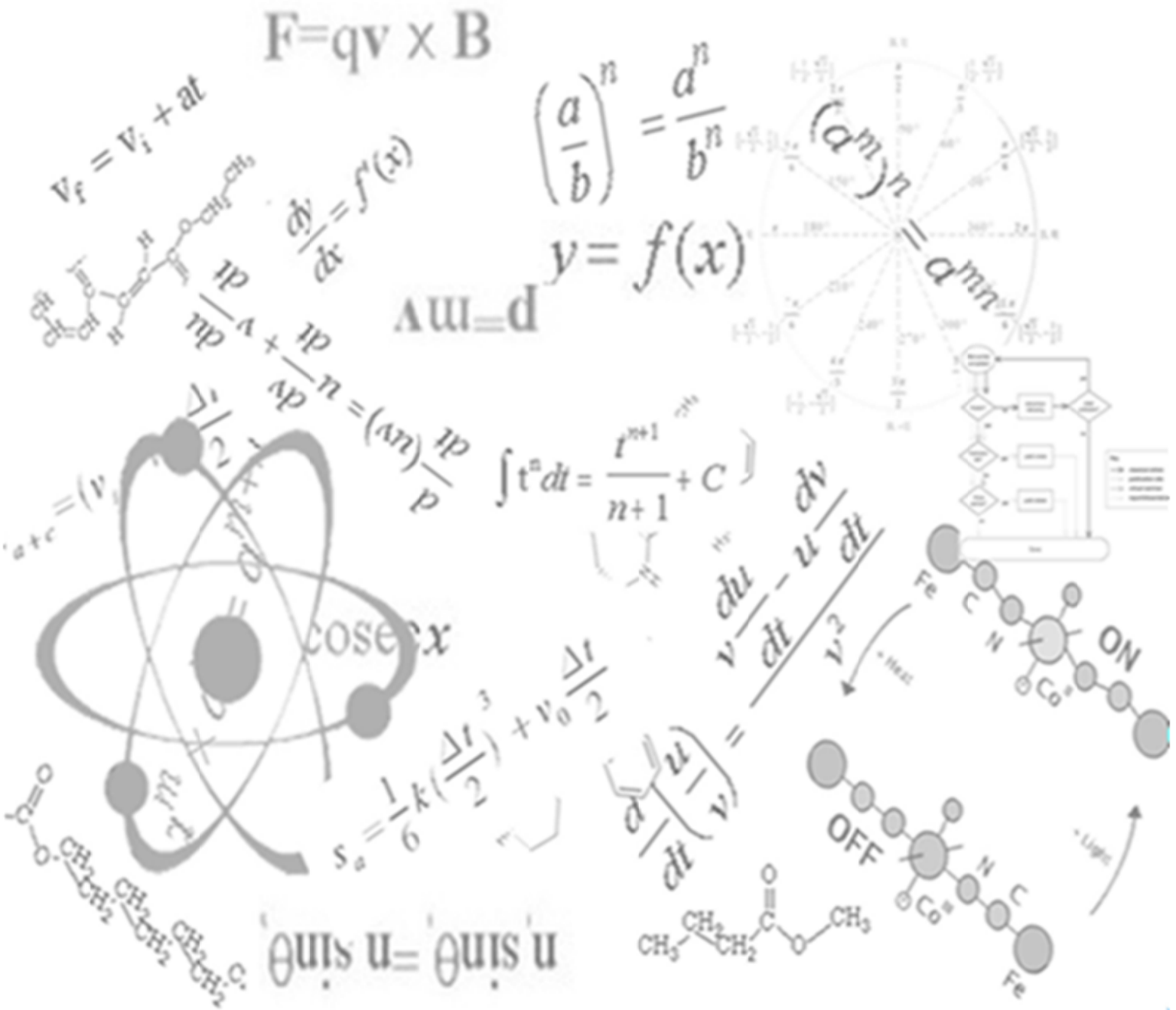
S4S coaching

Year 12- Chemistry

The Acidic Environment



Acidic Environment

Questions

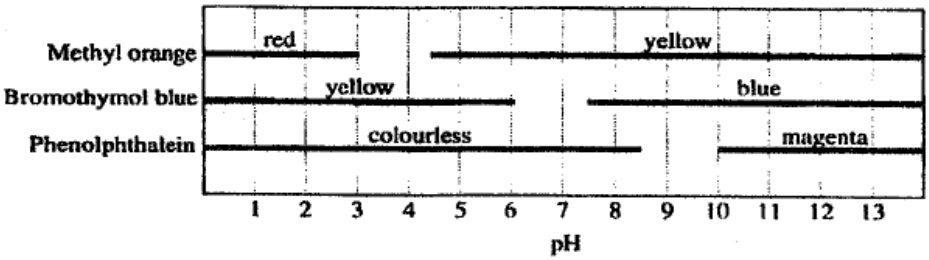
1. Indicators were identified with the observation that the color of some flowers depends on soil composition.

1. (4 marks)

Classify ethanol, HCl, NaOH and ethanoic acid as either acidic/basic/neutral.

2. (4 marks)

The graph shows the colour changes of the acid-base indicators methyl orange, bromothymol blue and phenolphthalein.



A student used a pH meter and bromothymol blue indicator to test 0.1 mol/L solutions of HCl and acetic acid.

Use the above example to distinguish between destructive and non-destructive testing procedures and analyse the different results that will be obtained from using the two procedures.

3. (3 marks)

Define the term indicator and identify 2 commercial and naturally occurring substances which can be used as indicators, and what must be done so these can be used as indicators.

4. (4 marks)

Describe how you could use one or more of the indicators in the image above to distinguish between three solutions having a pHs of 5.5, 8.0 and 10.3.

5. (2 marks)

Deduce the possible pH of a solution that is yellow with Bromothymol Blue and methyl orange.

6. (2 marks)

Deduce the possible pH of a solution that is yellow with methyl orange, blue with bromothymol blue and colourless with phenolphthalein.

7. (6 marks)

Describe the use of indicators in the testing of soil and 2 other uses.

8. (4 marks)

Identify a substance you used to prepare a natural indicator and outline the method you used to make and test the indicator and justify whether it was a suitable indictor or not.

9. (1 marks)

What is one risk factor you should consider when using indicators on acids and based?

2. While we usually think of the air around us as neutral, the atmosphere naturally contains acidic oxides of carbon, nitrogen and sulfur. The concentrations of these acidic oxides have been increasing since the Industrial Revolution.

1. (3 marks)

a) Describe how the acidity / basicity of oxides varies across period 3. (1 mark)

b) Write the equation for one of the oxides acting as a base and of the oxides acting as an acid (2 marks).

2. (3 marks)

Identify oxides of non-metals which act as acids and describe the conditions under which they act as acids and identify two ways we could test this.

3. (4 marks)

Define Le Chatelier's principal and identify factors that affect the equilibrium, making note of any affect that a catalyst has.

4. (3 marks)

Using Le Chatelier's principal, describe the effect of changes in pressure on the equilibrium when carbon dioxide dissolves in water.

5. (3 marks)

Explain the changes in solubility of carbon dioxide in water with the changes in temperature.

6. (7 marks)

Oxides of sulphur are readily released into the atmosphere with detrimental effects.

a) i) Identify the natural and industry sources of oxides of sulphur (2 marks)

ii) Use equations to show how two oxides of sulphur are formed. (2 marks)

b) Explain why oxides of sulphur are causing concern when released into the atmosphere. Use equations to support your explanation (3 marks).

7. (5 marks)

Identify and describe the main natural and industrial sources of sulphur dioxide in the atmosphere.

8. (5 marks)

Sulphur dioxide is produced by the smelting of copper sulphide ores.

a. Write a balanced equation showing this reaction. 1
b. Calculate the number of moles in 980 kg of copper sulphide. 1

c. Calculate the number of moles of sulphur dioxide produced. 1
d. What volume would this mass of sulphur dioxide occupy at 25^0 and 100kpa?

9. (7 marks)

Assess the evidence which indicates increases in atmospheric concentration of oxides of sulphur and nitrogen.

10. (4 marks)

Coal, containing 0.1 % sulphur, is burned in a power station.

Calculate the volume of sulphur dioxide released at 25 degrees and 100kPa when 10.0 million kg of coal is burned.

11. (2 marks)

What volume of hydrogen gas produced at 100 kPa pressure and 25 degrees C when 0.15 mol zinc reacts with excess HCL.

12. (5 marks)

Explain the formation and effects of acid rain.

13. (3 marks)

a. Write equations to show how sulphur dioxide is converted to sulphuric acid in acid rain.
b. Write an equation to show the reaction of sulphuric acid with marble (limestone).
c. Over a two year period, 5 grams of marble corrodes from a statue. How many grams of sulphur dioxide are needed to cause this corrosion?

14. (5 marks)

The procedure below was carried out to decarbonate a soft drink.

- Weight an unopened can of soft drink using an electronic balance

- Open the can

- Place the can on a hot plate until it just begins to boil.

- When cool, reweigh the can to determine the mass loss.

a) Explain why heating the soft drinks will cause the carbon dioxide to be lost (3 marks).

b) Describe a modification required to make the results valid for calculating the mass lass of carbon dioxide. (2 marks)

15. (4 marks)

Describe the method you used to decarbonate a soft drink and suggest one way the reliability and validity of the experiment can be improved.

16. (3 marks)

Evaluate reasons for concern about the release into the environment of sulphur dioxide and oxides of nitrogen.

3. Acids occur in many foods, drinks and even within our stomachs.

1. (3 marks)

Represent the ionisation of acetic acid

a) using an equation and (1 mark)

b) using a diagram to model the resultant solution (2 marks)

2. (2 marks)

Distinguish between a base and an alkali.

3. (3 marks)

Describe the ph scale.

4. (5 marks)

Aminoethance $C_2H_5NH_2$ is soluble in water and can act as a weak acid or base (at the NH_2 end).

a)

i) What is the name given to species that can act as both acids and base? (1 mark)

ii) Using equations clearly show how it acts as an acid and a base (2 marks)

iii) Underline one acid-base conjugate pair in the equation above.

b) Describe a simple test that could be performed in a school laboratory that would identify that $C_2H_5NH_2$ acts as a *weak* base in water. (2 marks)

5. (4 marks)

Describe acids and the differences between the terms strong, weak, concentrated and dilute.

6. (2 marks)

What is the hydrogen ion concentration of pH 5 and 10?

7. (3 marks)

In terms of ph, what is a neutral/acidic/alkaline solution?

8. (3 marks)

Explain why strong acids are better conductors of electricity than weak acids of the same concentrations.

9. (3 marks)

Ammonia is a weak base in water solution:

$NH_3(aq) + H_2O(l) \leftrightarrows NH_4^+(aq) + OH^-(aq)$

a. Why is ammonia classed as a base in this reaction? 2
b. Why is ammonia classed as a weak base in this reaction? 1

10. (4 marks)

Describe the method you used to use a pH probe/meter and indicators to distinguish between acidic, basic and neutral substances.

11. (2 marks)

Account for the use of acids as food additives.

12. (2 marks)

Calculate the pH when the hydrogen ion concentration is 0.1 and 0.001.

13. (2 marks)

Calculate $[OH^-]$, if $[H^+] = 10^{-6}$

14. (2 marks)

pH + pOH = 14, hence calculate pH when pOH = 3 and pOH when pH =3

15. (2 marks)

Find the pH of a 0.1 mol/L solution of sulphuric acid if it completely ionises.

16. (2 marks)

Find the ph of a 0.1 mol/L solution of NaOH.

4. Because of the prevalence and the importance of acids, they have been used and studied for hundreds of years. Over time, the definitions of acids and base have been refined.

1. (6 marks)

Different theories of acids and bases have been developed by Lavoisier, Davy, Arrhnius and Bronsted-Lowry. Sulphuric acid was classified as an acid by all these scientists.

Explain how each of their theories predict that H2SO4 is an acid. Support your answer by using equations where appropriate.

2. (8 marks)

a) Outline the differences between the definition of acids and bases proposed by Lewis and those by Bronsted-Lowry. (4 marks)

b) Explain how both the theories increased our understanding. (4 marks)

3. (6 marks)

a) Outline Davy's idea about acids. (1 mark)

b) Explain how Bronsted – Lowry theory of acids and bases was an improvement on previous ideas. (2 marks)

c) Define the term amphiprotic and use equations to describe the behaviour of an amphiprotic substance in acidic and basic solutions (3 marks).

4. (3 marks)

Identify three advantages of the Bronsted-Lowry theory of acids and bases over Arrhenius' theory.

5. (2 marks)

What is the conjugate acid of OH^- and the conjugate base of NH_3?

6. (3 marks)

Define the term amphiprotic and use equations to show that HSO_4^- is amphiprotic.

7. (4 marks)

Use net ionic equations to explain the amphiprotic nature of sodium hydrogen carbonate in acidic and basic conditions.

8. (4 marks)

Identify neutralisation as a proton transfer reaction which is exothermic.

9. (3 marks)

Define: titration, equivalence point and end point.

10. (2 marks)

During a titration, the acid and base are usually mixed in a flask. This flask is rinsed with water only and not with the solution to be placed in it, explain why this is done.

11. (2 marks)

How many times should titrations be carried out?

12. (6 marks)

List the steps to be carried out when performing a titration.

13. (3 marks)

Why is sodium hydroxide not suitable for a primary standard solution?

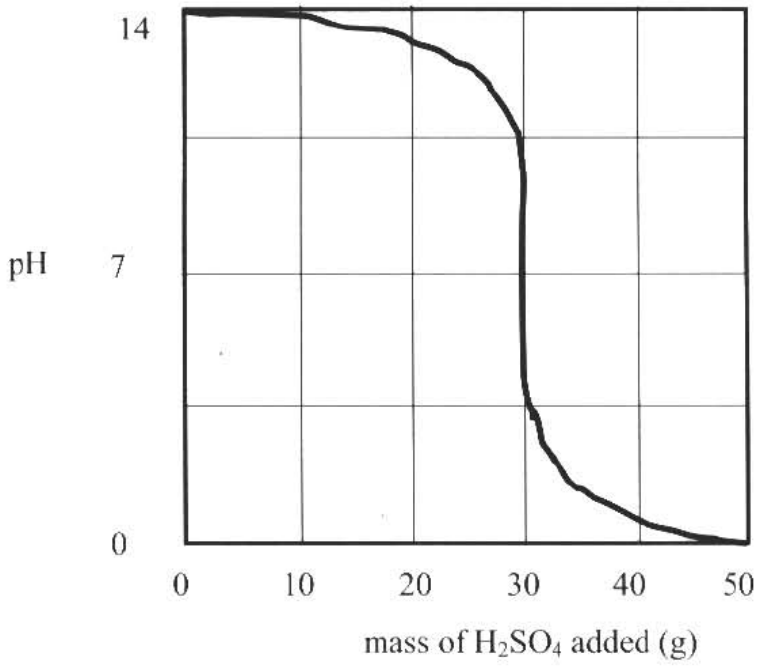
14. (4 marks)

What is a buffer? And use and describe an example of a buffer.

15. (4 marks)

A student added 20.0 mL of NaOH solution to a conical flask and placed it on a set of electronic scales, connected to a data logger. The balance was then zeroed.

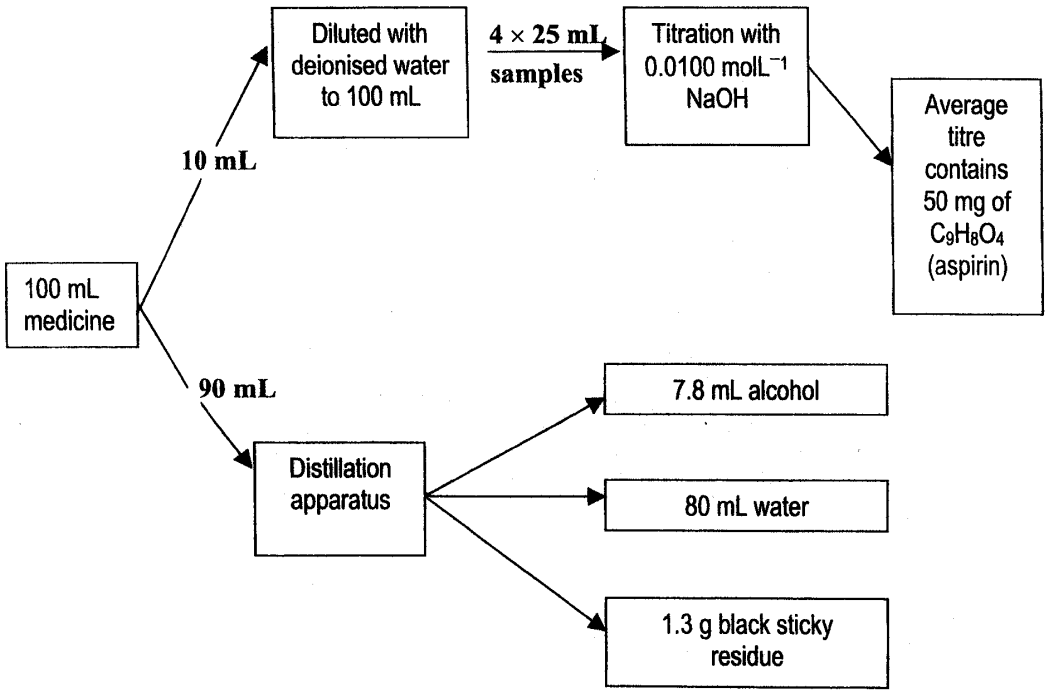
The NaOH was then titrated with excess 0.100 m/L sulphuric acid solution. The data logger was used to monitor the changes in pH and the mass in the reaction flask. The data from the logger was printed as a graph.



Assuming the solutions have a density of 1 g/mL, calculate the initial concentration of NaOH in the flask. (4 marks)

16. (4 marks)

A student analysed medicine using the following process.



Calculate the concentration of aspirin ($C_9H_8O_4$) in mol/L, in the original sample of medicine. Show all working.

17. (4 marks)

Find the volume of 0.15 mol/L NaOH that will neutralise 25 mL of 0.06 mol/L sulfuric acid.

18. (5 marks)

A standard solution of sodium carbonate was prepared by dissolving 3.25 g in distilled water and then making it up to 250 ml in a volumetric flask.

a. calculate the number of moles of sodium carbonate and its molarity. 3

b. this standard solution was titrated with HCl. 25 ml of sodium carbonate was used and was neutralised by 11.8 mL of HCL. Find the concentration of HCl 2

19. (4 marks)

A student determines the concentration of acetic acid (ethanoic acid) by titrating a sample of it that has been diluted by a factor of 5. 0.0950 mol/L NaOH was used for titration and the students results are shown below:

Volume of diluted ethanoic acid = 25 ml **Volume of NaOH (mL):**
1st titration - 34.2
2nd titration - 33.5
3rd titration – 33.7
4th titration – 33.6

a. Name and justify which indicator should be used. 2
b. Calculate the concentration of undiluted ethanoic acid 2

20. (2 marks)

A student performed a titration using NaOH and orange juice. Explain why phenolphthalein is a more suitable indicator than methyl orange.

21. (4 marks)

Assess the use of neutralisation reactions as a safety measure to minimise damage to in accidents or chemical spills.

5. Esterification is a naturally occurring process which can be performed in the laboratory.

1. (2 marks)
Outline the differences between the alcohol and alkanoic acid functional groups in carbon compounds.

2. (4 marks)
Complete the following:

propanol + ethanoic acid <==>

methanol + butanoic acid <==>

ethanol + propanoic acid <==>

methanoic acid + octanol <==>

3. (4 marks)
Explain the difference in melting and boiling point of alkanoic acids compared to alkanols

4. (2 marks)
What is esterification?

5. (2 marks)
What is the purpose of using a catalyst in esterification?

6. (5 marks)
Define reflux and explain the need for refluxing during esterification.

7. (3 marks)
Describe the uses of esters as flavors and perfumes in processed foods and cosmetics.

8. (4 marks)
a) Identify three chemicals needed to manufacture ethyl butanoate in a school laboratory. (2 mark)

b) Identify an ester and outline the use of this ester. (2 marks)