

ADVANCED HIGHER CHEMISTRY INVESTIGATIONS

1. CALCIUM CARBONATE IN PAPER

Chalk (calcium carbonate) is used to give a matt (non-shiny) finish to paper.

The more chalk used, the better the matt finish.

The mass of chalk used can be found by placing a weighed sample of paper in dilute hydrochloric acid. The chalk reacts and the paper can then be dried and reweighed.

2. HARDNESS OF WATER

When calcium or magnesium ions are present in water they make the water 'hard'. In this investigation you would obtain 3 samples of hard water and find techniques to compare their relative hardness. The hardness of water is known to change after boiling. You could use this knowledge to establish the permanent and temporary hardness of hard water.

3. BUFFERS

In this investigation you investigate the 'capacitance' of three buffers. Buffers are able to resist a change in pH, but only up to a certain point beyond which they collapse. A buffer 'recipe' could be altered and the effect investigated. The effect of temperature on the effectiveness of a buffer could be studied. By using a pH meter and probe, pH curves could be drawn to represent the changes taking place.

4. ENZYME ACTIVITY/EFFICIENCY

An enzyme based reaction such as the hydrolysis of starch could be studied. The effect of cations and anions on rate of reaction could be investigated. The effect of temperature could be studied to find the optimum temperature.

5. SOIL

Obtain different soil samples and investigate the water content, humus content, pH, phosphate levels, nitrogen content etc..

6. PARTITION COEFFICIENT

This would involve taking the PPA on Partition Coefficient [2.3] to the next stage. A number of variables could be studied – solute, non-aqueous solvent, temperature, volume of solvents, concentration of solute etc.

7. ANTACIDS

Antacids are designed to neutralise stomach acid. The efficiency of different brands could be studied by performing titrations. Factors such as volume of gas produced, time taken for complete reaction etc. might be investigated.

8. CHLORINE IN BLEACH

A variety of techniques are available for studying the amount of chlorine present in a bleach. Different brands could be purchased and the chlorine concentrations established. This could then lead to 'value for money'.

9. FERTILISERS

You could investigate the percentage composition of the elements present in three different N.P.K. fertilisers. Each element is analysed using a different technique. Value for money could be deduced from your results.

10. MOUTHWASH

Mouthwash contains ethanol. Techniques could be employed to try to establish the % ethanol in different brands of mouthwash.

11. VITAMIN C – IN ORANGE JUICE

Three different brands of orange juice could be analysed for their vitamin C content using two different techniques. This is an extension of a PPA carried out in the Higher Chemistry course. Value for money conclusion.

12. VITAMIN C – EFFECT OF COOKING/FREEZING/ STORAGE

Establish the levels of vitamin C in foodstuffs then introduce a change such as cooking, freezing, exposure to air then re-establish the vitamin C level. Two different techniques of analysis are required.

13. WINES – SULPHITE CONTENT

Sulphite ions are added to wines to prevent oxidation. Techniques could be used to compare the sulphite ion content of different wines. Other substances present which could be studied are total acidity and alcohol content. Differences between different types of wine (red, rose and white) could be studied.

14. VINEGAR

Purchase different brands or types of vinegar then analyse for ethanoic (acetic) acid content using at least two different methods.

15. IRON TABLETS

People who suffer from anaemia have a lack of iron in their blood. This iron is in the form of iron(II) ions (ferrous) which can be analysed in a number of ways. Different brands of iron tablet could be compared and analysed in at least two different ways. Techniques could involve colorimetry, volumetric analysis and gravimetric analysis.

16. FRUIT JUICES

An analysis of different types of fruit juice: pH, acidity, vitamin C.

17. CELL VOLTAGE

A simple investigation involving a quantitative study of the factors which affect the emf of a simple cell. For example, the output from a zinc/copper cell (Daniel Cell) could be investigated by altering concentration of solutions. Other variables include temperature, electrode area, depth of electrode etc.

18. OXIDATION OF ETHANOL

An investigation into the best conditions to bring about the oxidation of ethanol (or some other primary alcohol). Oxidising agents such as acidified permanganate or acidified dichromate could be employed and titration used to establish the quantity of acid formed.

19. IODINE FROM SEAWEED

Certain seaweeds can be used as a source of iodine. Here you could employ different techniques or conditions to extract iodine from three different species of seaweed.

20. SEA WATER

Samples of seawater from different locations around the Scottish coast could be analysed. Conductivity, ion content pH etc could all be investigated.

21. HOUSEHOLD CLEANERS

The aim is to find the 'best buy'. These cleaners contain oxidising agents and so iodimetry and other redox reactions can be employed to investigate this.

22. EQUILIBRIUM CONSTANT - ESTERIFICATION

Equilibrium constant refers to the ratio of products to reactants in a reversible reaction which has reached equilibrium. You could carry out an esterification reaction (Higher PPA 2.2) then try to establish the % ester present. The effect of changing temperature, concentration etc. could be studied.

23. CHLOROPHYLL

Investigate various ways of extracting chlorophyll from leaves then analysing the chlorophyll produced by different chromatographic methods. (Availability of leaves during winter months?) Autumn colours could be investigated.

24. CHROMATOGRAPHY

An investigation into the most effective chromatographic techniques for separation of colours in, say, food colouring. Column, thin layer and paper chromatography could be compared. Smarties could be used.

25. ASPIRIN

Following on from PPAs 3.4 and 3.5 different commercial aspirins could be analysed for their acetylsalicylic acid content using titrimetric techniques.

26. BROMINE WATER/HEXANE REACTION

Alkanes undergo a substitution reaction with bromine water in the presence of electromagnetic radiation of an appropriate frequency due to the homolytic fission of the bromine molecule. In this investigation you could study the relationship between the rate of decolourisation of the bromine water and the frequency and intensity of the light used.

27. HAIR DYE

There are many chemicals present in hair dyes – ammonia, hydrogen peroxide etc. You could purchase different colours of hair dye and see if there is a connection between the colour and the amount of these substances present.

28. ELECTROPLATING

An investigation into the best conditions for electroplating by studying the mass of copper deposited during the electrolysis of copper sulphate solution. Factors which could be altered are current, cathode area, concentration of electrolyte pH of electrolyte etc..

29. TRANSITION METAL CATALYSTS

The aim would be to investigate the effect that different transition metal salts have on the rate of say the zinc/hydrochloric acid reaction. Other factors which could be studied would be to see if the anion affects the catalytic efficiency of the metal ion and whether the rate of reaction is affected by the concentration of the catalyst.

30. END POINT OF A WEAK ACID/WEAK ALKALI TITRATION

The aim is to find a reliable method of determining the end-point in a weak acid/weak alkali titration. This could involve use of a pH meter, conductivity meter, Universal indicator and thermometric titrations.

31. IODIDE/IRON(III) RATE OF REACTION.

An investigation into how the rate of reaction varies with concentration and temperature of reactants. The order of reaction with respect to the various ions could be found.

32. CALCIUM CARBONATE

An investigation into the quantity of carbon dioxide produced when different types of calcium carbonate are reacted with acid. Examples could include chalk, limestone, egg-shell. The results could be used to establish the percentage purity of the calcium carbonate present.

33. CHALK

The principal ingredient in chalk is calcium carbonate. This could be analysed by adding to acid and studying how much acid is neutralised, what volume of gas is produced, what drop in mass occurs etc.

33. FIZZY DRINKS

Fizzy drinks are rich in sugar. Quantitative Benedict's solution can be used to find the quantity of sugar present. Other substances present which could be analysed include carbon dioxide content, pH, colouring etc.

34. EQUILIBRIUM CONSTANT - PRECIPITATION

Lead sulphate and potassium iodide react to form insoluble lead iodide. The precipitate is allowed to settle and a sample of the clear liquid above is removed and analysed for iodide using silver nitrate solution. The process is repeated but the conditions are altered.

35. IRON

The iron present in wire, nails etc can be analysed by dissolving the metal in acid then titrating with acidified permanganate solution. A second procedure could involve adding ferroxyl indicator to the iron solution and using a colorimeter to analyse the iron content.

36. CHOCOLATE.

In this investigation different non-aqueous solvents can be used to extract the fat in different types of chocolate to establish the % fat in each. Quantitative Benedict's solution can be used to find the sugar content.

37. SWEETS

Sweets are rich in sugar, often contain acids and usually have colour. These three substances could be investigated.

38. CAFFEINE

Tea, coffee and drinks such as 'Red Bull' contain caffeine. You could investigate and compare the caffeine content of these different drinks.

39. RHUBARB LEAVES

Oxalic acid is present in rhubarb leaves. Redox titrations and acid-base titrations could be used to study the oxalic acid content of rhubarb. The effect of cooking/storage could be investigated.