Laboratory safety Rules

1) Contact lenses should not be worn in the lab.
2) Clothing must be secured and shoes must completely cover the foot.
3) A lab coat, gloves should be worn during lab. Experiments.
4) If a chemical should splash in your eyes or on your skin, quickly wash directly with
the water.
5) All chemicals in the lab are dangerous because of that do not taste, or smell any
chemicals.
6) Never return unused chemicals to their original container.
7) Never work alone in the lab.
8) In the lab area, do not touch any equipment, chemicals, or other materials that are
not part of your experiment.
9) Do not drink or eat food in the lab.
10) Always work in a well-ventilated area.
11) Read carefully instructions of equipment before use.
12) Keep hands from face, eyes, mouth, and body while using chemicals or lab
equipment and wash your hands with soap and water after performing all experiments.
13) Never remove chemicals or other materials from the lab area.
14) Do not inter hot glassware in cold water.
15) Do not operate a hot plate by yourself and take care that hair, clothing, and hands
are a safe distance from the hot plate at all times.
16) Never look into a container that is being heat.

Instrument Name

1) Bunsen burner: used to heat substances.

2) Graduated cylinder: accurately measures liquid volumes.

3) Pipet: To transfer a measured volumeof liquid, it is used for very small volumes.

Crucible tongs: to hold hot crucibles.

Burette: or delivering known volumes of a liquid, especially in titrations

Balance: An Instrument for Determining weight

Stirring rod; used for stirring

Evaporating dish: liquids are heated over a flame so that they evaporate, leaving a solid residue

watch glass: to hold solids while being weighed.

Beaker: used to hold liquids

Thermometer: measures temperature (Science uses degrees in Celsius)

Erlenmeyer flask: used to hold liquids,as narrow neck to prevent splashes

Volumetric flask: for making up solutions to a known volume

Filter paper: special paper used to separate solids from liquids
Funnel: for pouring liquid or other substance through a small opening
Test tube rack: holds 5-6 test-tubes in a row
Wash bottle: used to rinse various Pieces of laboratory glassware
Test Tube: Open Tube Used To Hold Liquid

Centrifuge: Is a device that **uses** centrifugal force to separate various components of a fluid. This is achieved by spinning the fluid at high speed within a container, thereby separating fluids of different densities (e.g.liquids from solids).
Spectrophotometer: is a method to measure how much a chemical substance absorbs light by measuring the intensity of light passes through sample solution.
Water path: A water bath is laboratory device made from a container filled with heated water. It is used to incubate samples in water at a constant temperature.

Detection of Cations
is a branch of chemistry concerned with identifying the constituents of a substance
and finding how much of each constituent is in the substance

Types of Analysis:
1- Qualitative Analysis
2- Quantitative Analysis
qualitative analysis: Identifying the constituents is called.
quantitative analysis: Finding how much of one or more constituents are present in a given amount of the substance is called.
Include the following ions

Theory :-

Ag^{+}, Pb^{+2} and Hg^{+2}
The silver ion , mercury ion and lead ion are precipitate as chloride from hydrochloric acid solution , Rationale softest acids react strongly enough with a border line base to precipitate in acid solution , so the cation group I can be separated from the other groups since they form slightly soluble chloride with the addition of hydrochloric acid , the other groups will remain in solution thus allowing the group I chloride precipitate to be removed and further tested .
The precipitating reaction are :-
$Ag^{+} + HCl \rightarrow AgCl_{(s)}$
(p.p.t white)
$Hg_2^{+2} + 2HCl \rightarrow Hg_2Cl_{2(s)}$
(p.p.t white)
$Pb^{+2} + 2HCl \rightarrow PbCl_{2(s)}$
(p.p.t white)

Chemistry of the separation and identification of group I cations
the lead chloride may be extracted from the other two chlorides which may also be in the precipitate with hot water since its solubility increase with an increase in temperature much more markedly than do the solubilities of silver chloride and mercury chloride و**$PbCl_2$ A needle white precipitate while AgCl cloudy white precipitate.**
$PbCl_2 + H_2O_{(hot)} \rightarrow Pb^{+2} + 2Cl$The presence of lead ion is confirmed by adding an aqueous solution of potassium chromate which provides chromate ion to form lead chromate which it a bright yellow solid and less soluble than lead chloride :

$Pb(NO)_2 + K_2CrO_4 \rightarrow PbCrO_{4(s)}$ (yellow p.p.t)

$AgNO_3 + K_2CrO_4 \rightarrow AgCrO_{4(s)}$ (red p.p.t)

The silver chloride and the mercury chloride which may be in the precipitate may be separate from one another by taking advantage of the fact that only silver ion forms a soluble complex ion with ammonia by adding ammonia water to the residue , the silver chloride selectively dissolve due to the formation of the soluble diammine silver (1) ion

$AgCl + 2\ NH_4OH \rightarrow [Ag(NH_4)_2]^+ + Cl^- + H_2O$

This type of reaction seen with mercury is called a disproportionation reaction where the Hg2Cl2(s) oxidizes and reduces itself to Hg(black) and [HgNH4]Cl(white) so the mix of the two gives a gray precipitate . The formation of the insoluble a gray precipitate products serves as confirming evidence for the original presence of mercury (+1).

Lec5

PH

pH measurement is very important in chemistry, biology, medicine, and industry. Many chemical and biological reactions occur only within a narrow pH range. Therefore, solutions that can resist changes in pH (buffer solutions) and accurate instruments (pH meter) are essential in laboratory work.

Buffer Solutions

A **buffer solution** is a solution that resists changes in pH when small amounts of acid or base are added.

Types of Buffer Solutions

1. Acidic Buffer

Consists of:

• A **weak acid**

• Its **conjugate base (salt)**

Example:

• Acetic acid (CH_3COOH)

• Sodium acetate (CH_3COONa)

2. Basic Buffer

Consists of:

• A **weak base**

• Its **conjugate acid (salt)**

Example:

• Ammonia (NH_3)

• Ammonium chloride (NH_4Cl)

• **Principle of Buffer Action**

• When a small amount of **acid (H^+)** is added, it is neutralized by the

conjugate base.
• When a small amount of **base (OH^-)** is added, it is neutralized by the weak acid.
As a result, the **pH remains nearly constant**.

Preparation of Buffer Solutions (Practical)

Example: Preparation of Acetic Acid Buffer (pH ≈ 4.76)

Chemicals Required:
• Acetic acid (CH_3COOH)
• Sodium acetate (CH_3COONa)
• Distilled water

Apparatus:
• Volumetric flask
• Beaker
• Measuring cylinder
• Glass rod

Procedure:
1. Measure a known volume of **acetic acid solution**.
2. Measure an equal volume (or calculated amount) of **sodium acetate solution**.
3. Transfer both solutions into a volumetric flask.
4. Add distilled water up to the mark.
5. Mix the solution well.
6. Measure the pH using a **pH meter**.

pH Calculation (Henderson–Hasselbalch Equation):
Henderson–Hasselbalch equation:
pH = pKa + log (salt / acid)

. pH Meter
A **pH meter** is an electronic instrument used to measure the pH of a solution accurately.

Parts of pH Meter
• Glass electrode
• Reference electrode
• Digital display

Principle of Operation
The pH meter works by measuring the **potential difference** between the glass electrode and the reference electrode. This potential depends on the concentration of **hydrogen ions (H^+)** in the solution.

Calibration of pH Meter
Calibration must be done before measurement.

Steps:
1. Turn on the pH meter.
2. Rinse the electrode with distilled water.
3. Immerse the electrode in **standard buffer solution (pH 7)**.

4. Adjust the meter to read pH 7.
5. Repeat calibration using **pH 4 or pH 9 buffer**.
6. Rinse the electrode again.

Measurement of pH

1. Rinse electrode with distilled water.
2. Place the electrode in the test solution.
3. Stir gently.
4. Wait until the reading becomes stable.
5. Record the pH value.

Preparation of Solutions of Known pH

Method 1: Using Buffer Solutions

• Prepare buffer using weak acid/base and its salt.
• Measure pH using pH meter.
• Adjust pH if necessary.

Method 2: Using Standard Buffer Tablets

1. Dissolve one buffer tablet in a specific volume of distilled water.
2. The solution will have a fixed and known pH (e.g., pH 7).

Method 3: Using Strong Acid or Base (Approximate pH)

Examples:

• 0.01 M HCl → pH ≈ 2
• 0.01 M NaOH → pH ≈ 12

This method gives **approximate values only** and is not suitable for precise work.

Precautions

• Always calibrate the pH meter before use.
• Do not touch the glass electrode.
• Rinse electrode before and after each measurement.
• Use fresh buffer solutions.
• Handle acids and bases carefully.

. Conclusion

In this experiment, buffer solutions were prepared and their pH was measured using a pH meter. The ability of buffer solutions to resist changes in pH was observed. Accurate preparation and measurement of pH are essential in laboratory and industrial applications.

Oxidation – Reduction Reactions

Preparation of Potassium Permanganate Solution

Oxidation–reduction reactions are important chemical reactions involving transfer of electrons.

Potassium permanganate is a strong oxidizing agent used widely in laboratory analysis.

Oxidation and Reduction

Oxidation is loss of electrons or increase in oxidation number.
Reduction is gain of electrons or decrease in oxidation number.

Example:
$Zn \rightarrow Zn^{2+} + 2e^-$ (Oxidation)
$Cu^{2+} + 2e^- \rightarrow Cu$ (Reduction)
Oxidizing and Reducing Agents
Oxidizing agent causes oxidation and is reduced.
Reducing agent causes reduction and is oxidized.
Potassium Permanganate ($KMnO_4$)
Properties:
• Purple crystalline solid
• Strong oxidizing agent
• Self-indicator in titration
Preparation of Potassium Permanganate Solution
Important note:
$KMnO_4$ is not a primary standard and must be standardized.
Chemicals:
• Potassium permanganate
• Distilled water
Apparatus:
• Balance
• Beaker
• Volumetric flask
• Funnel
Procedure:
1. Weigh an approximate amount of $KMnO_4$.
2. Dissolve it in distilled water.
3. Heat gently to dissolve completely.
4. Cool and filter the solution.
5. Transfer to volumetric flask.
6. Dilute to the mark with distilled water.
7. Mix well.
Use in Redox Titration
$KMnO_4$ oxidizes Fe^{2+} or oxalic acid.
End point is appearance of faint pink color.
Example reaction:
$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$
. Precautions
• Use clean glassware
• Add solution slowly
• Observe color change carefully
• Store in dark bottle

Conclusion

Oxidation–reduction reactions are essential in chemistry.
Potassium permanganate is an important oxidizing agent in volumetric analysis.

Lec6

Balance

The primary method that you will use to measure the amounts of chemicals is to weigh them--that is, to determine their mass. To do this you use a balance. You'll be learning to use two balances: a standard laboratory balance and an analytical balance. Balances of the late 20th century were usually electronic and far more accurate than mechanical balances
The classic balance in the laboratory. Compact size, practical for small spaces

Volumetric measurements

Volumetric measurements of liquids are made with measuring cylinders, burettes, or pipettes. The measuring cylinder is usually used to measure approximate volumes of liquids. Aqueous solutions wet the glass walls, forming a concave meniscus, the bottom of the meniscus is used to indicate the volume of the liquid. To avoid parallax error (caused

by change of observational position), your eye should always be level with the meniscus when you are making a reading.

Preparing chemical solutions

The mole

The mole is a unit of measurement used to describe the amount of a chemical
species. It can be used to describe the number of atoms, molecules, ions, electrons,
etc. The abbreviation of mole or moles is mol.
One mole contains 6.022×1023 particles (atoms, molecules, ions, electrons). This
is known as Avogadro’s number.

Molarity

molarity is the most frequently used method of expressing concentration of a
solution. **Molarity** indicates the number of moles of solute dissolved in a litre of a

solution; has the symbol M, and the unit, moles per litre (mol/L)
Ass. Lecture: Eatmad Alshawi practical Analytical chemistry
4

A molar solution

The symbol M is pronounced ‘molar’. Molar solutions use the molecular weight of
a solute to calculate molar concentration in a litre of solution.
The molecular weight can be found on the chemical bottle label, in a data book or
safety data sheet (SDS), or by adding together the atomic weights of all of the
atoms, which appear in the chemical formula of the substance.

Example 1: Calculation for preparing 1 litre of a 0.5 M copper (II) sulfate
solution

Note that we are using copper (II) sulfate pentahydrate, (CuSO4.5H2O)
$Molecular\ weight = MW$ = 63.55 + 32.06 + (4x15.99) + ((**2x1. 008**) + **15. 99**))
= 249.68 g
$Concentration = c$ = 0.5 M
$Volume = V$ = 1 L
The quantity of the solid copper sulfate pentahydrate required to make 1L of 0.5M
solution
m = $c\ x\ V\ x\ MW$
= 0.5 x 1 x 249.68= 124.84 g

preper sudiume carbonate in labortary

Expermental:

To preper 0.2M of Na2CO3 voumetric fask 100ml must follow up
meny steps
1. Weighting Na2CO3 balance
2. Disolve wgiht from Na2CO3 by enough amount water
3. Add solution into volumetric flask 100ml
4. Add water to reach to the marke
Ass. Lecture: Eatmad Alshawi practical Analytical chemistry
5

Normality:

It is the number of gram equivalents of solute present in one litre of the solution and it is denoted by N.
The relation between normality and molarity.
N x Eq.Wt = Molarity x Molar mass
N = Molarity x Valency
N = Molarity x Number of H+ or OH– ion.

N = Weight of Solute (gram) × [Equivalent weight × Volume (L)]

Prepper 0.2N of H_2SO_4 in laboratory

experiment:

to preper solution must be follow meny steps

1. Weighting H_2SO_4 balance
2. Add H_2SO_4 enough amount water
3. Add solution into volumetric flask 100ml

4. Add water to reach to the marke

Solution Dilution

We are often concerned with how much solute is dissolved in a given amount of solution. We will begin our discussion of solution concentration with two related and relative terms: **dilute** and **concentrated**.

- A **dilute** solution is one in which there is a relatively small amount of solute dissolved in the solution.
- A **concentrated** solution contains a relatively large amount of solute.

These two terms do not provide any quantitative information (actual numbers), but they are oft Dilutions of Stock (or Standard) Solutions

Imagine we have a salt water solution with a certain concentration. That means we have a certain amount of salt (a certain mass or a certain number of moles) dissolved in a certain volume of solution. Next, we will dilute this solution. This is done by adding more water, not more salt:

→→

Before Dilution and After Dilution

$M_1V_1 = M_2V_2$

Or

$N_1V_1 = N_2V_2$

Preparing dilutions is a common activity in the chemistry lab and elsewhere. Once you understand the above relationship, the calculations are simple.

Suppose that you have 100.mL of a 2.0M solution of HCl . You dilute the solution by adding enough water to make the solution volume 500.mL . The new molarity can easily be calculated by using the above

equation and solving for M2 .
M2=M1×V1V2=2.0M×100.mL500.mL=0.40MHCl

Prepper dilution solution for Nitric acid

Nitric acid (HNO3) is a powerful and corrosive acid. When ordered from a chemical supply company, its molarity is 16M . How much of the stock solution of nitric acid needs to be used to make 8.00L of a 0.50M solution

experiment:

prepper dilute solution from Nitric acid with depending on the information on the bottle in the your lab the solution prepper must be 0.1M.

Lec8

Carbohydrates

Polyhydric aldehydes or ketones are composed of carbon, hydrogen and oxygen The latter two are present in the same ratio with water and their general formula is (Cn H2n On). The origin of carbohydrates from plants through photosynthesis.

.- :Carbohydrates have functions or benefits, including

1-.synthetic. (Involved in the structure of the tough cell wall, such as cellulose)
2-An energy store. (as starch and glycogen)
3-A source of energy. Like glucose ATP

Categories of carbohydrates

The number of building blocks that sugar contains:
- Carbohydrates can be stated based on
1-Monosaccharides (simple sugar) they contain Its formulas contain one sugar unit, such as glucose, fructose,
2- Oligosaccharides (including disaccharides) Its constituents contain 2-10 units of monosaccharides, such as maltose, sucrose , and lactose.
3-.Polysaccharides, which are large polymeric structures They are monosaccharides
, and they have a high number of molecules, and they, in turn, are divided into two important groups, depending on the reason
The structural units of repeat monosaccharides of one or two types, so the two types are divided:
A- Homogeneous polysaccharides: - Saccharide Poly Homo.
B- Heteropolysaccharides: - Saccharide poly Hetero..

Molisch's Test
which is a general detection of carbohydrates Where the concentrated H2SO4 acid is dehydrated (a drying agent, not an oxidizing agent) Glycosidic bond to give monosaccharides lose in turn (3 molecules) of water to give Furfural and its derivative, which in turn combine (condensate) with alpha-alcoholic (α-naphthol) alcoholic naphthol) and the appearance of the violet complex in the form of a ring.

Materials used in the experiment
1- carbohydrate solution
2-Concentrated sulfuric acid
3-Alpha-naphthol solution

Procedure
1-We take in a test tube 5 milliliters of sugar solution.
2-Add 3-5 drops of alpha-naphthol solution to it, then shake well.
3 -then we add about 1 milliliter of concentrated sulfuric acid to the contents of the tube, provided that the tube is in an inclined position, and the addition is done very slowly.

conclusion
- In positive cases (carbohydrates), a violet ring appears at the boundary between the acid and the sugar solution, spreading with shaking.
- In negative cases (other than carbohydrates), a violet ring does not appear, and it may appear in another form (black or brown), and it is not considered a positive result.

Lec9

Benedict's test

Benedict's test is used to test simple carbohydrates. Benedict's test detects reducing sugars (monosaccharides and some disaccharides), which contain free ketone or aldehyde functional groups. Benedict's solution can be used to test for the presence of glucose in urine.
Benedict's test is a biochemical test developed by the American chemist S.R. Benedict. This test requires the use of a solution known as Benedict's solution, which consists of a mixture of aqueous copper (II) sulfate and a mixture of .sodium citrate and sodium carbonate.
Some sugars such as glucose are called reducing sugars because they are able to transfer hydrogen (electrons) to other compounds, and this process is known as the reduction process. When reducing sugars are mixed with

Benedict's reagent and then heated, the reduction reaction causes the Benedict's reagent to change color. The color varies from green to dark red (brick) or rusty brown, depending on the quantity and type of sugar.
Benedict's Test Principle
When Benedict's solution with simple carbohydrates is heated, the solution changes to an orange/brick red. This reaction occurs due to the reducing property of simple carbohydrates. The copper(II) ions in Benedict's solution are .reduced to copper(I) ions, causing the color change
The red copper oxide (I) formed is insoluble in water and precipitates out of the solution, and with increasing concentration of reducing sugar, the closer the final color to brick red and also the greater the precipitate formed.
How to take Benedict's Test
When the solution is detected, the mixture is mixed with the solution in a test tube, and then the mixture is boiled. If a red precipitate forms, this indicates the presence of reducing sugars in a high concentration, but if a yellow color appears, this indicates that the concentration of the reducing sugars is low. Benedict's test is more accurate than Fehling's test.
Benedict's reagent preparation:
In the presence of heat, dissolve 173 grams of sodium citrate and 100 grams of sodium carbonate in 800 ml of water, dissolve 17.3 grams of aqueous copper (II) sulfate in 100 ml of water, add the second solution to the first solution and dilute the mixture to obtain a homogeneous solution of capacity 1 Liter.
The reason for using sodium carbonate, copper sulfate and sodium citrate
Sodium carbonate provides the necessary alkaline conditions for the redox reaction, and so on Sodium carbonate, Na_2CO_3, is an important component of Benedict's test, as it is present when reducing sugars are detected, and an alkaline medium is available, which the reducing sugars need to remain in their natural state.
As for sodium citrate, with copper (II) ions, it forms a complex composed of sodium citrate and copper (II), and this prevents the transformation of copper (II) into copper (I) ions during storage.

Lec10

Fehling's test
Monosaccharides contain, without exception, aldehyde or ketone groups free in their aqueous solutions, so they were all considered to have a high reducibility in comparison Disaccharides, which may be non-reducing, such as sucrose, or weakly reducing as maltose and lactose depending on the way they are bound two saccharide molecules, and therefore the

reductive property of sugars will be studied through the following disclosures
Fehling's test A chemical test for the detection of reducing sugars and aldehydes in solution, developed by the German chemist Fehling. Fehling's solution consists of Fehling's solution A (aqueous copper (II) sulfate) and Fehling's solution B (a mixture of sodium hydroxide and sodium tartrate “Rochelle salt” dissolved in water).

The method of work;
)1(Mix two equal volumes of Fehling's solutions A and B, so take (1 ml) of Fehling's solution A and add to it (1 ml) of Fehling's solution B, and the resulting solution becomes distinguished by its dark blue color (this solution is considered It is suitable for use when its color does not change when boiling, and on the contrary, a precipitate appears, ranging in color from yellow to brown..
)2(After that, (2 ml) of the sugar solution to be detected is added to the reagent with direct heating. On the flame and to the point of boiling until a red or yellow to brown color appears from the copper oxide in a condition The presence of reducing sugar, on the contrary, the color remains dark blue. The red color is obtained after 3-5 minutes.
conclusion:
• The appearance of a reddish-brown precipitate indicates a positive result and
the presence of reducing sugars.
• The absence of the reddish precipitate or the appearance of deep blue color
indicates a negative result and lack of reduce.

Lec11

Detection of polysaccharides:
Iodine Test:
Polysaccharides are tasteless and odorless compounds. They consist of the union of a large number of molecules Monosaccharides linked to each other by glycosidic bonds forming chains Of different lengths.
Polysaccharides are of two types, either homogeneous, such as starch and chalcogen and cellulose or heterogeneous such as acar, hemicellulose and pectin. Characteristics of multiple sugars:
1.Its high molecular weight -
2- .It does not exist in a crystalline state -
3-. Its hydrolysis yields several units of monosaccharide**s** –

Detecting basis:
This detection depends on the iodine formation of adsorption colored complexes (compounds.) with polysaccharides, where iodine adsorbs on their surfaces to give distinctive colors .The examination is sensitive to heat, and it is not correct to perform it except in acidic and cold neutral media, and we will come later To detail it right.
Materials and reagents:
1- Solution Iodine: Prepare (0.050 standard) of iodine (l2) in
(3) % of potassium iodide.)
2- Solutions (1%) of each: glycogen, starch
Inulin, and dextrin.)
How to work: Method
Add (5) iodine solution to (1) milliliter of sugar solution in a Test tube (the solution is diluted with distilled water if it is dark in color) The contents are heated the tube to the boiling point, where it is noticed that the previously formed color disappears and appears when it cools and when you continue to heat intensely, the color disappears and does not reappear due to evaporation iodine
Conclusion: -
1-Cellulose is a polysaccharide of the glucose unit, as it is not formed by - iodine Unless it was treated with concentrated salts in an acidic medium (Bevan solution) consisting of Zinc chloride and hydrochloric acid, HCl, then convert to amyloid A blue color component with iodine.
2-.Dextrin gives a violet color with iodine -
3-Starch can be detected by iodine in an acidic or neutral medium, but it is - not suitable detection in alkaline medium due to the reaction of free iodine with the base converted to iodide salts and iodate.

Lec12

Proteins:

They are complex organic substances consisting of multiple amino acids and functional bonds Particularly peptide bonds. Carbon and hydrogen are considered guarantors It contains some proteins and nitrogen is the main elements of proteins, and sometimes elements such as Phosphorus, sulfur, iron and copper.
Notes:
1- Proteins are the main component of animal and plant tissues, both in terms of structure or function.
2- Proteins abound in animal and plant products, such as eggs, meat, and seeds, as there are some Special proteins as in wool, hair and animal skins.

3- Proteins differ from each other in the number, quality and sequence of their constituent amino acids.

Amino acids:

They are carboxylic acids that contain an amino group attached to an alpha carbon atom attached to the carboxyl group). The amino acids differ among themselves according to the R side chain.

Experiment: Testing the solubility of proteins

Test objective

Clarify the nature of proteins as giant molecules that contain active groups with electric charges, especially in the side chains of amino acids such as NH3+, NH2+, NH+, COO-, S-, O- .....etc. Also, they are amphoteric substances. Many proteins dissolve in water due to the attachment of polar water molecules to the active groups in the protein, and they form colloidal solutions due to the large size of the protein molecules. It increases the attraction between the molecules and causes their aggregation and sedimentation.

In an acidic medium with respect to the point of electrical equilibrium, the molecules are symmetrical due to the presence of a positive charge, which prevents the deposition of particles, as well as in an alkaline medium with respect to the point of electrical equilibrium. Where the particles are negatively electrically charged.

Materials:

Egg albumen solution - hydrochloric acid and sodium hydroxide solution.

Method:

Test the solubility of the egg whites in water, in a hydrochloric acid solution, and in a sodium hydroxide solution.

The study of protein solubility is of great importance in the separation and extraction of proteins

Proteins depend on several factors, including:

The type of side chains of amino acids

Structure of outer protein (globular Olivier)

Others are related to external factors such as the ionic strength of the solution - the degree of pH - degree Temperature - type of solvent used.

Biuri's experiment:

When a solution of copper sulfate (OH-, CuSO4) is added in an alkaline medium to a protein solution, a complex is formed between the copper ion and the peptide bonds of the protein, and a violet color appears

The intensity of the staining is directly proportional to the number of peptide bonds.

Materials:
Copper sulfate $CuSO_4.5H_2O$ 1% solution
Sodium Hydroxide 10M, Sodium chloride
Protein: 0.5% albumin- solution. Will dissolved in a dilute sodium chloride solution.

Method:
Add 5 drops of copper sulfate solution to 2 mL of protein solution and then add 2 mL of NaOH solution. Mix the solutions by shaking and note the color formed.