وزارة التعليم العالي والبحث العلمي
الجامعة التقنية الجنوبية
المعهد التقني العمارة
قسم تقنيات المختبرات الطبية

الحقيبة التدريسية لمادة الكيمياء التحليلية

……

الصف الاول

تدريسي المادة
م.لينا محمد زكي

الفصل الدراسي الاول

جدول مفردات مادة الكيمياء التحليلية

الاسبوع	المفردات
1	Introduction to analytical chemistry Atom , elements, radio . isomers pollution with radio isomers , pollution with elements
2	Relation between atoms, molecules ,energy, according to the new .theory of atom.(Debroley equation). Matter , classification
3	.Chemical bonds, covalent ,Ionic , coordination , hydrogen Methods of analysis . qualitative and quantitative ,statistical
4	Methods of expressing concentration of solution , Molar solution . ,normal solution ,preparation, dilution.
5	Percentage composition, part per million chemical Chemical equilibrium, ionization, constant of water (PH and . POH)
6	Ionization of weak electrolyte . calculation of PH of weak acids .and weak bases , Buffer solutions , classification
7	Calculation of buffer solutions Uses of buffer solutions
8	.Volumetric analysis , classification , standard , example Neutralization reactions
9	.Oxidation ,reduction reactions . examples .Precipitation reactions
10لا	Theory of indicators , reaction , properties ,examples. Types of indicators.
11	. Principles of colorimetry
12	. Beer-lambert law
13	.Standard solution/calibration curve
14	.Instruments of colorimetry
15	Examination

الهدف من دراسة مادة الكيمياء التحليلية (الهدف العام):

تهدف دراسة مادة الكيمياء التحليلية للصف الاول الى:

1) Use and clean laboratory equipment
2) . Can able to act with different chemical reagents
3) . Can able to prepare different concentration solution
4) Can be identify the biochemistry compound of
5) human being by using laboratory and chemically. methods
6) . Can able to use the laboratory instrument

الفئة المستهدفة:

طلبة الصف الاول / قسم تقنيات المختبرات الطبية

التقنيات التربوية المستخدمة:

1. الشاشة الذكية smart screen
2. عارض البيانات Data Show
3. جهاز حاسوب محمول Laptop

Week 1

Introduction to analytical chemistry

General aims :

The student is introduced to the concept of analytical chemistry, the structure of the atom and elements, radioactive isotopes, and their environmental impact, while .understanding the relationship between atoms.

Chemistry is the science that study composition, structure and properties of matters and the interaction between them. Or

- It is the study of the interaction behavior of electrons
  - **Analytical Chemistry** deals with methods for determining the chemical composition of samples. its divided to:

1.Qualitative Analysis (identification) its operation used to know the type of species present in compound or mixture

2. Quantitative Analysis its operation used for determination the quantity of species present in substance or mixture in unit.

3.Instrumental Methods: Analytical measurements (conductivity, electrode potential, light absorption or emission, mass-to-charge ratio, fluorescence etc.) by use instrument.

Atom - It is the smallest unit of a substance. All atoms are made up of a number of protons, neutrons and electrons.
Element - It is a substance that cannot be further resolved into simpler substances by chemical means. It consists of a single type of atom of same number of protons. For example, gold and copper are elements with 100% gold atoms and 100% copper atoms, respectively.
Molecules - This is the smallest unit of a compound. For example, water is dihydrogen oxide. The water molecule consists of two hydrogen atoms and one oxygen atom which bind together by covalent bonds.

Chemical Pollutants

Type Examples Sources

Heavy metals Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (As) Batteries, industry, waste

Organic compounds Pesticides, solvents, dioxins Agriculture, factories, burning trash
Fertilizer chemicals Nitrates (NO_3^-), Ammonium (NH_4^+), Phosphates (PO_4^{3-})
Overuse in farming
Acids and bases Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Sodium hydroxide (NaOH) Industrial spills
Toxic gases Carbon monoxide (CO), Nitrogen oxides (NO_x), Sulfur dioxide (SO_2)
Cars, power plants

Effects of Chemical Pollution

- On Human Health:

Breathing problems (from air pollutants)

Kidney and liver damage (from heavy metals)

Cancer (from some organic chemicals)

Birth defects and developmental delays (from mercury and lead)

- On the Environment:

Fish and aquatic life die (due to oxygen depletion or toxicity)

Soil becomes infertile

Food chain is disrupted (due to bioaccumulation

Week 2

theory of atom.(Debroley equation). Matter , classification

Aim of Lec

The student understands the types Debroley equation). Matter , classification

Energy:

The effort of power; the capacity to do work, taking the forms of kinetic energy, potential energy, chemical energy, electrical energy, and other types.

The de Broglie equation

is a fundamental concept in quantum mechanics that expresses the wave-particle duality of matter. It shows that all matter has wave-like properties, .especially significant for very small particles like electrons

:de Broglie Equation 📄

lambda = \frac{h}{p}\

:Where

wavelength of the particle (in meters) =

= Planck’s constant =

:momentum of the particle = , where =

mass of the particle (in kg) =

velocity of the particle (in m/s) =

:Interpretation 🔍

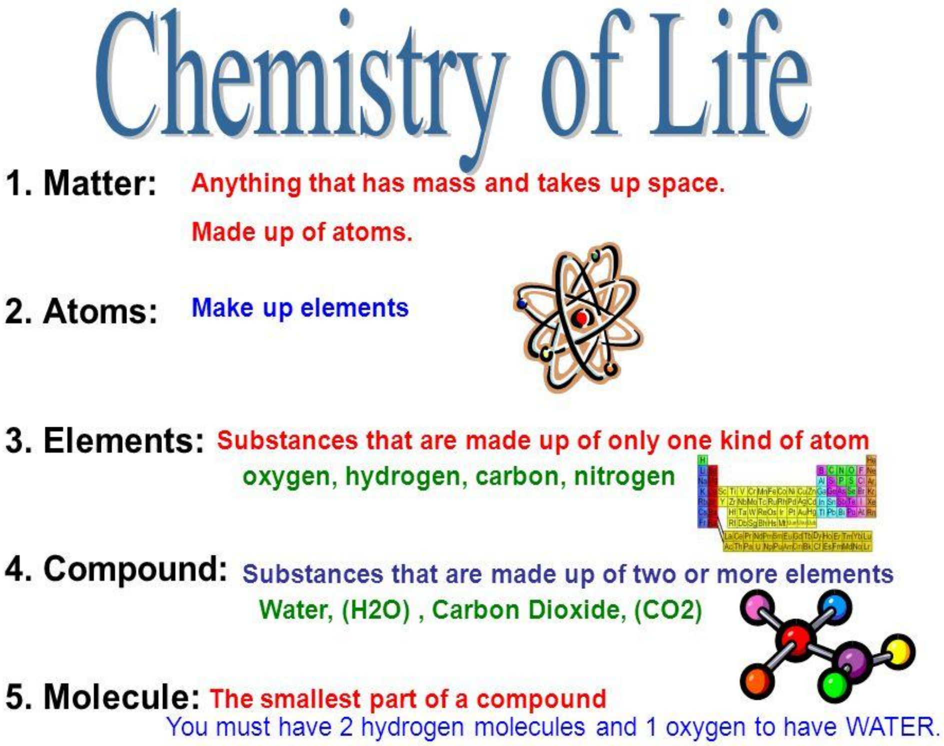
.Proposed by Louis de Broglie in 1924

It implies that particles such as electrons can exhibit wave behavior, like .diffraction and interference

This idea was experimentally confirmed by electron diffraction .experiments (Davisson-Germer experiment)

:Example □

If an electron has a mass of kg and is moving at m/s (typical speed in :hydrogen atom), then



Chemistry of Life

1. Matter: Anything that has mass and takes up space.

Made up of atoms.

2. Atoms: Make up elements

3. Elements: Substances that are made up of only one kind of atom

oxygen, hydrogen, carbon, nitrogen

4. Compound: Substances that are made up of two or more elements

Water, (H_2O) , Carbon Dioxide, (CO_2)

5. Molecule: The smallest part of a compound

You must have 2 hydrogen molecules and 1 oxygen to have WATER.

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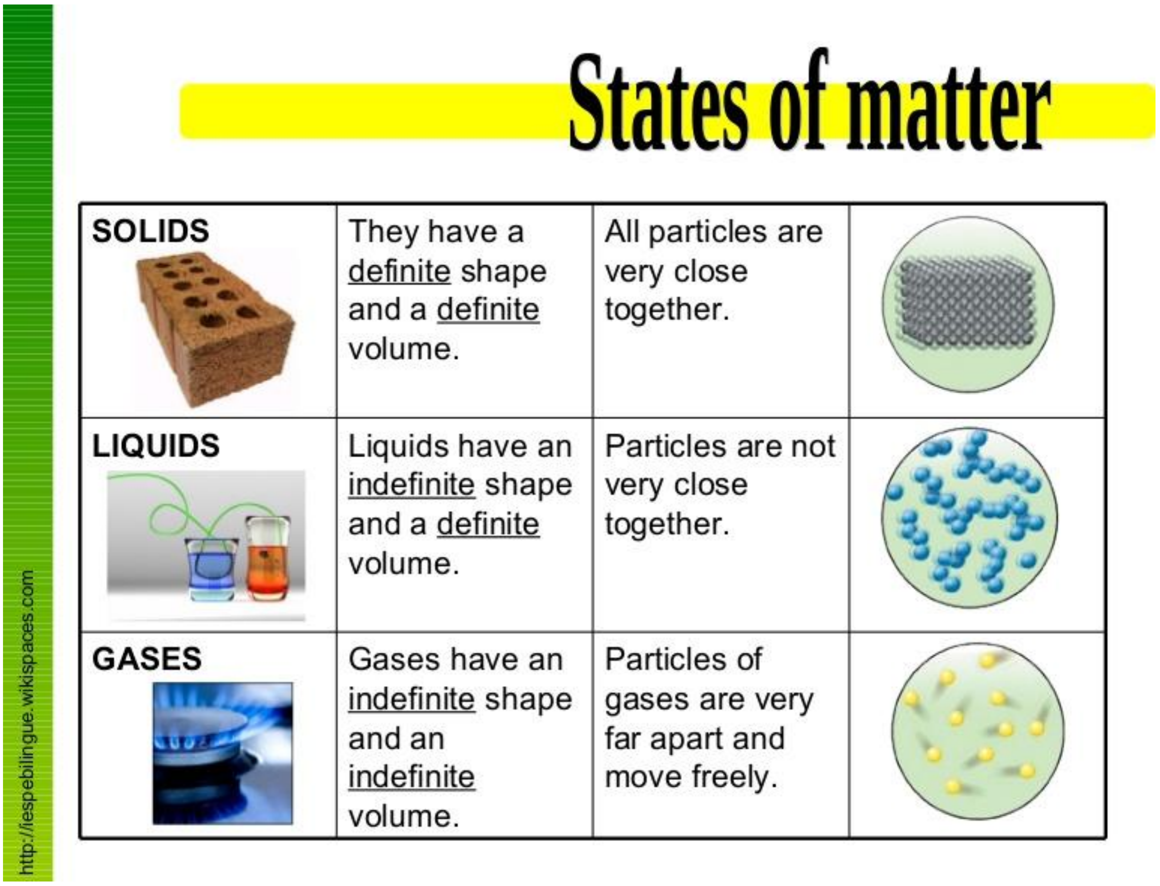


States of matter

SOLIDS	They have a definite shape and a definite volume.	All particles are very close together.	
LIQUIDS	Liquids have an indefinite shape and a definite volume.	Particles are not very close together.	
GASES	Gases have an indefinite shape and an indefinite volume.	Particles of gases are very far apart and move freely.	

http://iespebilingue.wikispaces.com

Week 3

Chemical bonds:-

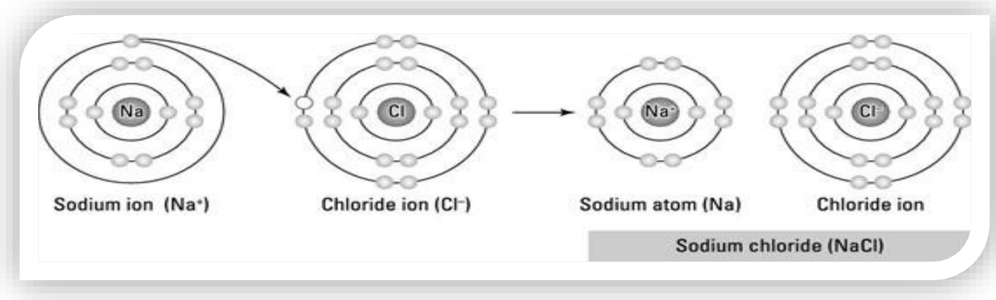
Aim of Lec

The student understands the types of chemical bonds (covalent, ionic, coordination, and hydrogen bonds) and is introduced to qualitative and quantitative analysis methods, the foundations of statistical analysis, and potential errors**.**

is a lasting attraction between atoms that enables the formation of chemical compounds. The bond may result from the electrostatic force of attraction between atoms with opposite charges, or through the sharing of electrons as in the covalent bonds. The strength of chemical bonds varies considerably; there are "strong bonds" such as covalent or ionic bonds and "weak bonds" such as hydrogen bonding.

Ionic bonding

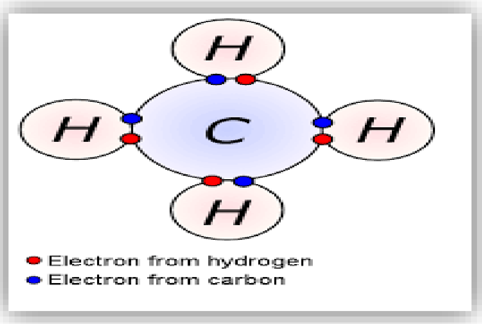
is a type of electrostatic interaction between atoms which have a large difference electronegativity. This chemical bond involves a transfer of an electron, so one atom gains an electron while one atom loses an electron. One of the resulting ions carries a negative charge (anion), and the other ion carries a positive charge (cation). Because opposite charges attract, the atoms bond together to form a molecule.fig(1)



fig(1) show ionic bond of NaCl

2. Covalent bond

The most common bond in organic molecules, a covalent bond involves the sharing of electrons between two atoms. The pair of shared electrons forms a new orbit that extends around the nuclei of both atoms, producing a molecule. There are two secondary types of covalent bonds that are appropriate to biology — polar bonds and hydrogen bonds.



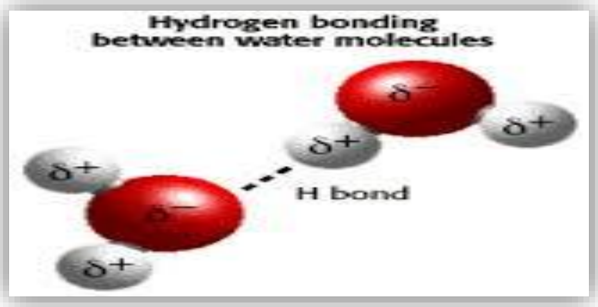
fig(2) Covalent bond

3. Hydrogen bond

A chemical bond in which a hydrogen atom of one molecule is attracted to anelectron e-gative atom, especially a nitrogen, oxygen, or fluorine atom, usually of another molecule.

Because they're polarized, two adjacent H_2O (water) molecules can form a linkage known as a *hydrogen bond*, where the (electropositive) hydrogen atom of one H_2O molecule is attracted to the (electronegative) oxygen atom of an adjacent water molecule.

Consequently, Hydrogen bonds have only about 1/20 the strength of a covalent bond, yet even this force is sufficient to affect the structure of water, producing many of its unique properties, such as high surface tension, specific heat, and heat of vaporization. Hydrogen bonds are important in many life processes, such as in replication and defining the shape of DNA molecules.



fig(3) Hydrogen bond

week 4

Lec Expressing concentration of solution

aim of Lec

The student acquires skills in calculating percentages and concentrations **in Molarity and normality.**

Solution (Sol.) المحلول

It is a homogenous mixture of two or more substance in which the particles are atomic or molecular size, there for it composed of

a- Solute

b- Solvent

Solution types could be:

1- Solid in liquid ex: NaCl in H2O.

2- Liquid in liquid ex: HCl in water.

3- Gas in liquid ex: CO2 in H2O.

4- Gas in gas ex: Helium in Oxygen.

5- Solid in Solid ex: Fe in Al ex: Alloy

6- Liquid in solid ex: Hg in Cu Mercury in copper

7- Gas in solid ex: H in Pd

Aqueous solution: A solution in which the solvent is H2O

Concentration

The amount of solute dissolved in amount of solvent to form the solution, when a solution contains small amount of the solute it's said to be diluted; when it contains large amount of solute it's said to be concentrated. There are four ways to express the concentration:

1. Percentage
   a. W/W
   b. V/ V
   c. W/V

2. Molarity (M)

3. Normality (N)

4. Part per million (P.P.M)

Percent volume n. of mls. of solute dissolved in 100ml. Of solution.

$$\% \text{ volume} = \frac{\text{volume solute (ml)}}{\text{volume solution (ml)}} \times 100$$

Percent mass

$$\% \text{ mass} = \frac{\text{mass solute (g)}}{\text{mass solution (g)}} \times 100$$

Solution = solvent + solute

$$\text{mass/volume } \% = \frac{\text{g solute}}{\text{mL solution}} \times 100\%$$

Expressing concentration of solution

- **Molarity M** : is the number of moles of solute dissolved in one liter of solution. The units, therefore are **moles per liter**, specifically it's **moles of solute** per **liter of solution**.

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liter of solution}}$$

Example 1. What is the molarity of a 5.00 liter solution that was made with 10.0 moles of KBr ?

Solution:

$$\text{Molarity} = \frac{\text{of moles of solute}}{\text{Liters of solution}}$$

Given: of moles of solute = 10.0 moles
Liters of solution = 5.00 liters

$$\text{Molarity} = \frac{\text{10.0 moles of KBr}}{\text{5.00 Liters of solution}} = 2.00 \text{ M}$$

$$\text{Molarity} = \frac{\text{Weight (g)}}{\text{Molecular Weight (g/mol)}} \times \frac{1000}{\text{Volume (ml)}}$$

Molecular Weight = Sum. Of atomic weight

Example : Prepare 0.1 M of NaCl in 250 ml of D.Water from Solid?

Wt= M x M.wt. x V(ml) / 1000

= 0.1 x 55.5 x 250 / 1000

= 1.38 mol/L

- **Normality** : is the number of equivalents of solute dissolved in one liter of solution. The units, therefore are **equivalents per liter**, specifically it's **equivalents of solute** per **liter of solution**.

$$\text{Normality} = \frac{\text{No. of equivalents of solute}}{\text{liter of solution}}$$

$$\text{No. of equivalents} = \frac{\text{Weight (g)}}{\text{Equivalent Weight (g/eq)}}$$

$$\text{Normality} = \frac{\text{Weight(g)}}{\text{Equivalent weight (g/eq)}} \times \frac{1000}{\text{Volume(ml)}}$$

$$\text{Eq.Wt} = \frac{\text{M.Wt}}{n}$$

n = No. of (H) atoms for acids

for HCl n=1

n = No of OH groups for bases

for NaOH n=1

n = No of Cation atoms (M+) for salts

for Na_2CO_3 n= 2

- **Relationship between Molarity and Normality**

$$\text{Molarity} = \frac{\text{Weight (g)}}{\text{Molecular Weight (g/mol)}} \times \frac{1000}{\text{Volume (ml)}}$$

$$\text{Normality} = \frac{\text{Weight(g)}}{\text{Equivalent weight (g/eq)}} \times \frac{1000}{\text{Volume(ml)}}$$

$$\text{Eq.Wt} = \frac{\text{M.Wt}}{\text{N}}$$

$$\boxed{N = M \times n}$$

Q / what is the normality of 0.1 mol / l of Na_2SO_4 ?

Week 5
Expressing concentration of solution

Aim of Lec

The student acquires skills in calculating percentages and concentrations in parts per million.

- **Weight – Volume Percentage (% w/v)**

$$\boxed{\% \text{ w / v} = \frac{\text{Weight of solute (g)}}{\text{Volume of solution (ml)}} \times 100}$$

- **Weight – Weight Percentage (% w/w)**

$$\% \text{ w / v} = \frac{\text{Weight of solute (g)}}{\text{Weight of solution (g)}} \times 100$$

- **Volume – Volume Percentage (% v / v)**

$$\% \ w / v = \frac{\text{Volume of solute (ml)}}{\text{Volume of solution (ml)}} \times 100$$

Q/ What is the weight/volume percentage concentration of 250mL of aqueous sodium chloride solution containing 5g NaCl?

Calculate the weight/volume (%) = mass solute ÷ volume of solution x 100
mass solute (NaCl) = 5g
volume of solution = 250mL

w/v (%) = 5g ÷ 250mL x 100 = 2g/100mL (%)

Q / 2.0L of an aqueous solution of potassium chloride contains 45.0g of KCl. What is the weight/volume percentage concentration of this solution in g/100mL?

Convert the units (mass in grams, volume in mL):
mass KCl = 45.0g
volume of solution = 2.0L = 2.0 x 10^3mL = 2000mL

a. Calculate w/v (%) = mass solute (g) ÷ volume solution (mL) x 100
w/v (%) = 45.0 ÷ 2000mL x 100 = 2.25g/100mL (%)

EX: How many grams of NaCl would you need to prepare 200.0 mL of a 5 M solution?

Solution

g = M x L x molar mass

Diluting Solutions

$\mathbf{C_1V_1 = C_2V_2}$

C_1 – concentration of stock

C_2 - concentration of diluted solution

V_1 – volume needed of stock

V_2 – final volume of dilution

Example 5:

How many mls of a 5 M stock solution of NaCl are needed to prepare 100 ml of a 0.4 M solution?

$C_1 \ V_1 = C_2 \ V_2$

$(5) \ V_1 = (0.4)(100) \qquad V_1 = 8 \text{ ml}$

- Parts per Millions (PPM)

$$PPM = \frac{\text{Weight of solute (g)}}{\text{Volume of Solution (ml)}} \times 10^6$$

Standard solutions:

Its solution that contain known concentration of solute (element or substance).

Standard solutions are used to determine the concentrations of other substances. particularly use in titration

Characters of Standard solution

- Its easy to dry.
- Known structure.
- Highest purity.
- Water soluble.
- Not hydroscopic.
- Stable. Not expensive
- Not sensitive to high temperature
- It should have high equivalent weight

Week 6

Lec / PH Value and Buffers

The aim from lecture:
To knowledge PH Value and its importance

calculates the pH of weak acids and bases, and classifies buffer solutions according to their nature

Kw Water Ionization Constant

- Kw in chemistry represents the equilibrium constant when the water goes through the self-ionization process.
- Self-ionization case, means that water molecules donate and accept protons to form H3O+ and OH- ions. The former hydronium ion acts as a strong acid, the other hydroxide ion is a strong base.
- **$Kw = [H3O+][OH-]$ or $Kw = [H+][OH-]$**
- **$-\log K_w = -\log [H_3O^+] + -\log [OH^-]$**
- **$-\log 1 \times 10^{-14} = -\log [H_3O^+] + -\log [OH^-]$**

$pK_w = PH + POH = 14$

$PH+POH=14$

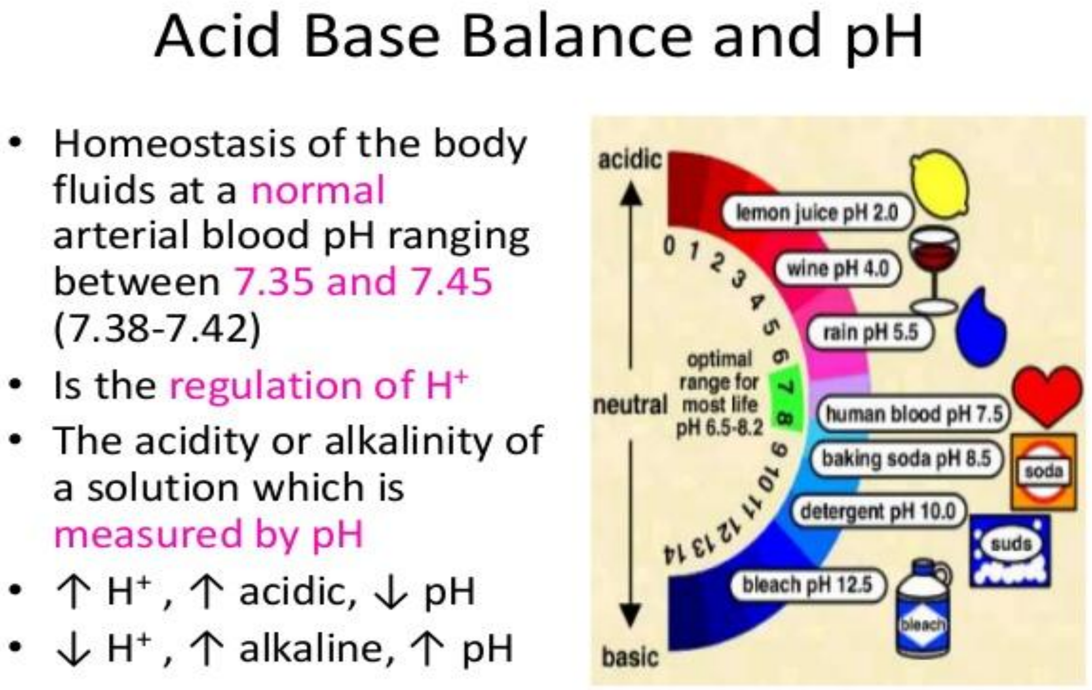
- **$pH = -\log[H+]$**
- **$POH=-\log [OH]$ or**
- **$[H]= 10^{-PH}$**
- **$[OH]= 10^{-POH}$**
-

PH Value define

- pH is a unit of measure which describes the degree of acidity or alkalinity (basic) of a solution.
- It is measured on a scale of 0 to 14.
- The formal definition of pH is the negative logarithm of the hydrogen ion activity.
- $pH = -\log[H+]$

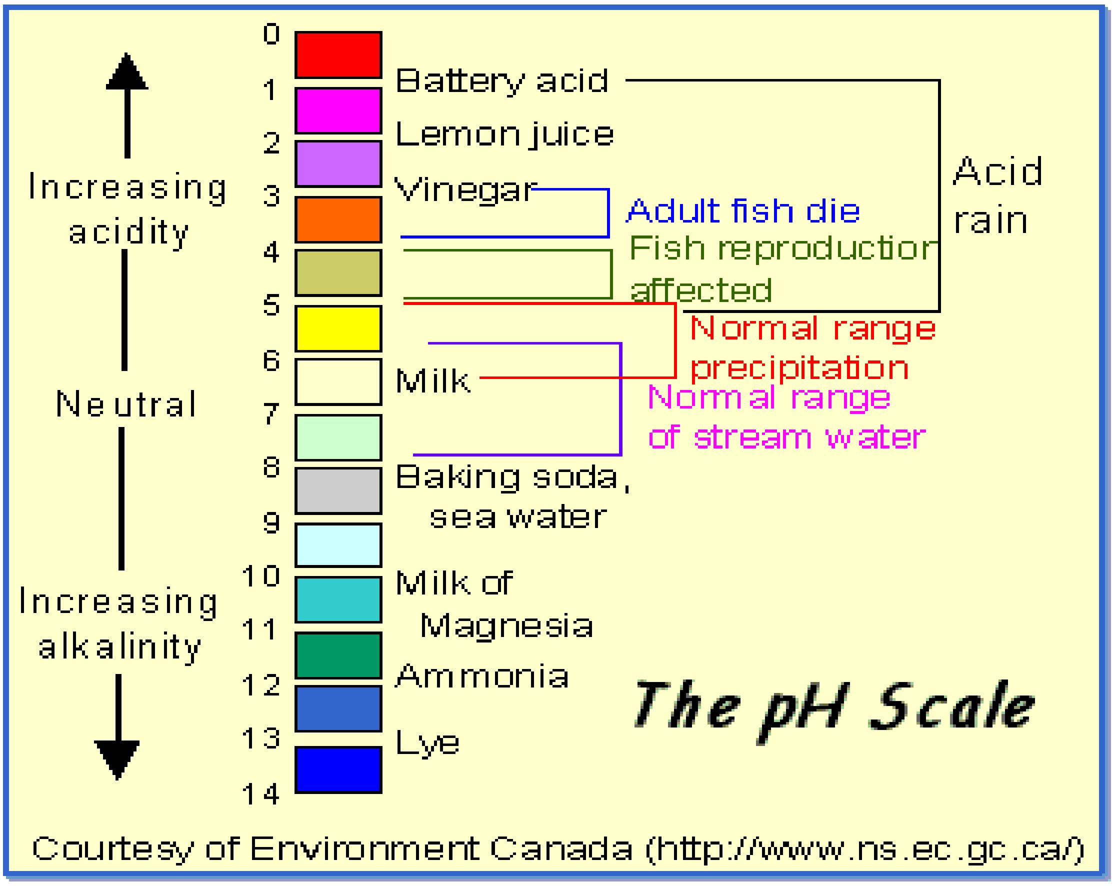
Acids and bases

- Acids have a lot of Hydrogen ions (H^+)
- bases have a lot of Hydroxide ions (-OH).
- A solution is neutral if its pH equals 7.



Acid Base Balance and pH

- Homeostasis of the body fluids at a normal arterial blood pH ranging between 7.35 and 7.45 (7.38-7.42)
- Is the regulation of H^+
- The acidity or alkalinity of a solution which is measured by pH
- ↑ H^+ , ↑ acidic, ↓ pH
- ↓ H^+ , ↑ alkaline, ↑ pH



Courtesy of Environment Canada (http://www.ns.ec.gc.ca/)

Week 7
Calculation, uses of buffer
Aim of Lec

The student learns how to calculate the concentration of buffer solutions using appropriate equations and understands their practical applications in chemical and biological systems

POH pH &

- PH+POH=14
- pH = -log[H+]
- POH=-log [OH] or
- POH =Log[1/OH]or[OH]=10 -POH

Ex/ **If an acid has an H+ concentration of 0.0001 M, find the pH.**

- **<u>Solution</u>**:
- اولا تحويل العدد إلى الأس، إيجاد اللوغاريتم، ثم حل معادلة الرقم الهيدروجيني.

- $H^+ = 0.0001M = 10^{-4}$; log of $10^{-4} = -4$;
- $pH = - \log [H^+] = - \log (10^{-4}) = - (-4) = +4 = pH$

Questions

Most OH- ions: pH = 10; or pH = 13.
- Least H+ ions: pH = 12; or pH = 13.
- Least OH- ions: pH = 8; or pH = 9.

Buffers

Buffers are the solutions which resist changes in pH when small amounts of acid or alkali is added to them.

A buffer is a pair of weak acid and its salt.

Buffers are of main importance in regulating the pH of the body fluids and tissues

Many biochemical reactions including those catalyzed by enzymes require pH control which is provided by buffers

- Acids are H^+ donors.
- Bases are H^+ acceptors, or give up OH^- in solution.
- Acids and bases can be:
- Strong – dissociate completely in solution
    - HCl, NaOH
- Weak – dissociate only partially in solution
    - Lactic acid $CH_3CH(OH)CO_2H$, carbonic acid H_2CO_3

The Body and pH

- Homeostasis of pH is tightly controlled
- Extracellular fluid = 7.4
- Blood = 7.35 – 7.45
- < 6.8 or > 8.0 death occurs
- Acidosis (acidemia) below 7.35
- Alkalosis (alkalemia) above 7.45

Important not Small changes in pH can produce major disturbances

- Most enzymes function only with narrow pH ranges
- Acid-base balance can also affect electrolytes (Na^+, K^+, Cl^-)
- Can also affect hormones

Week 8

volumetric analysis, types of titrations

aim of Lec

The student learns the principles of volumetric analysis, types of titrations, how to prepare standard solutions, and the application of neutralization reactions in analysis.

Standard solutions:

Its solution that contain known concentration of solute (element or substance).

Standard solutions are used to determine the concentrations of other substances. particularly use in titration

Characters of Standard solution

- Its easy to dry.
- Known structure.
- Highest purity.
- Water soluble.
- Not hydroscopic.
- Stable. Not expensive
- Not sensitive to high temperature
- It should have high equivalent weight

- **Volumetric analysis**

is a common technique used in chemistry to determine the concentration of an unknown substance in a solution the common method is titration.

The volumetric analysis can be classified into three types:

- **1. Simple titration**
- **2. Back titration**
- **3. Double titration**

- The main aim of simple titration is to find the concentration of an unknown solution with the aid of the known concentration of another solution (standard solution).
- Simple titration can again be classified into different types:

Simple titration can again be classified into different types:

- • Acid-base titrations (Neutralization)
- • Redox titrations
- • Precipitation titrations

Acid-base titrations

Titration is commonly used to determine the concentration of an acid or base in a solution.

- Neutralization reactions involve the reaction of an acid and a base to produce a salt (ionic compound) and water.

  Acid + Base → Salt + Water

  Example: $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

  (Net Equation: $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$)

- This process involves a solution of known concentration (the **titrant** or standard solution) delivered from a burette into the unknown solution (the **analyte**) until the substance being analyzed is just consumed.
- The volume of titrant is recorded and the moles of titrant can then be calculated using $n = C \bullet V$, where n = number of moles, C = concentration in mol/L and V = volume in L.
- The moles of H^+ = moles of OH^- at this point (called the **equivalence point**).

Week 9:

Titration of oxidation-reduction reactions

Aim of Lec:

The student understands oxidation-reduction reactions, as well as precipitation reactions, in terms of their principles, types, and analytical examples

Oxidoreduction (Redox) Titration

📌 Definition:

A redox titration is a type of volumetric analysis based on an oxidation-reduction (electron transfer) reaction between the titrant and analyte.

⚗□ Principle:

One substance is oxidized (loses electrons).

The other is reduced (gains electrons).

The reaction proceeds until equivalence point, where the moles of oxidizing agent = moles of reducing agent.

□ Common Redox Titrants:

Potassium permanganate ($KMnO_4$) – strong oxidizer, acts as its own indicator (purple to colorless).

Iodine (I_2) – often used in iodometry and iodimetry.

Potassium dichromate ($K_2Cr_2O_7$) – also a strong oxidizer, often used in acid medium.

🎯 Indicators:

Some redox titrations are self-indicating (e.g., $KMnO_4$).

Others use external indicators (e.g., starch with iodine).

✅ Examples:

1. Titration of Fe^{2+} with $KMnO_4$:

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$

2. Precipitation Titration

📌 Definition:

A volumetric method based on the formation of an insoluble precipitate during the reaction between analyte and titrant.

⚗□ Principle:

The analyte reacts with a reagent to form a sparingly soluble salt. The point at which the reaction is complete is the equivalence point, detected using specific indicators.

□ Common Systems:

Halides (Cl^-, Br^-, I^-) with silver nitrate ($AgNO_3$).

The insoluble product: AgCl, AgBr, etc.

🎯 Indicators:

Adsorption Indicators: e.g., Fluorescein in the Mohr method, which changes color when Ag^+ is in slight excess.

Turbidity or color change can also be an indicator.

Week 10

Theory of indicators

Aim of Lec:

The student learns the theory of chemical indicators, their properties, and types, and applies this to selecting the appropriate indicator for various .titrations, along with practical questions

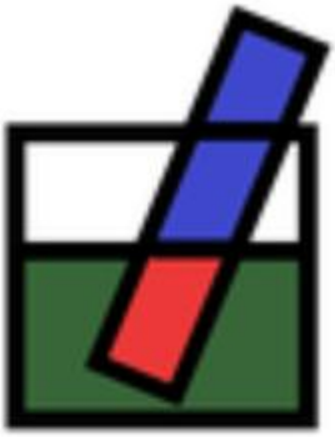
Indicators

Indicators are weak acids or weak bases that show a change in color as the concentration of Hydrogen ions in a solution changes or the pH of a solution changes. The indicators dissociate slightly in the water to form ions.

Natural Indicators

Natural Indicators: The indicators that occur naturally in the environment are called natural indicators. e.g. Litmus, Turmeric, etc.

Red litmus turns blue in base



Blue litmus turns red in acid

Artificial Indicators

Those indicators that are obtained through some chemical reaction but not naturally or are prepared artificially in the laboratory are artificial indicators. e.g. Phenolphthalein, Methyl orange, etc.

List of the indicators and their colors in acids and bases solution

Indicator	Colour in Acid	Colour in Base
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink
Litmus	Red	Blue
Turmeric	No change	Reddish Brown
Red cabbage	Red	Bluish Green

Week 11

Principles of colorimetry

Aim of Lec

The student understands the theoretical principles of colorimetry and its importance in estimating the concentrations of colored substances.

COLORIMETRY ANALYSIS

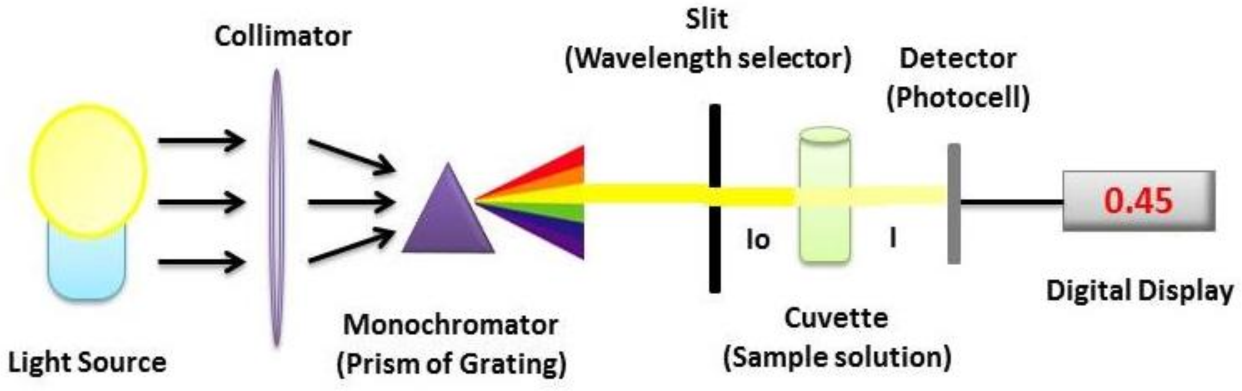
It's method to determination the solution's concentration by measuring the absorption of light with regard to standard solution

These instruments photometers or spectrophotometer .

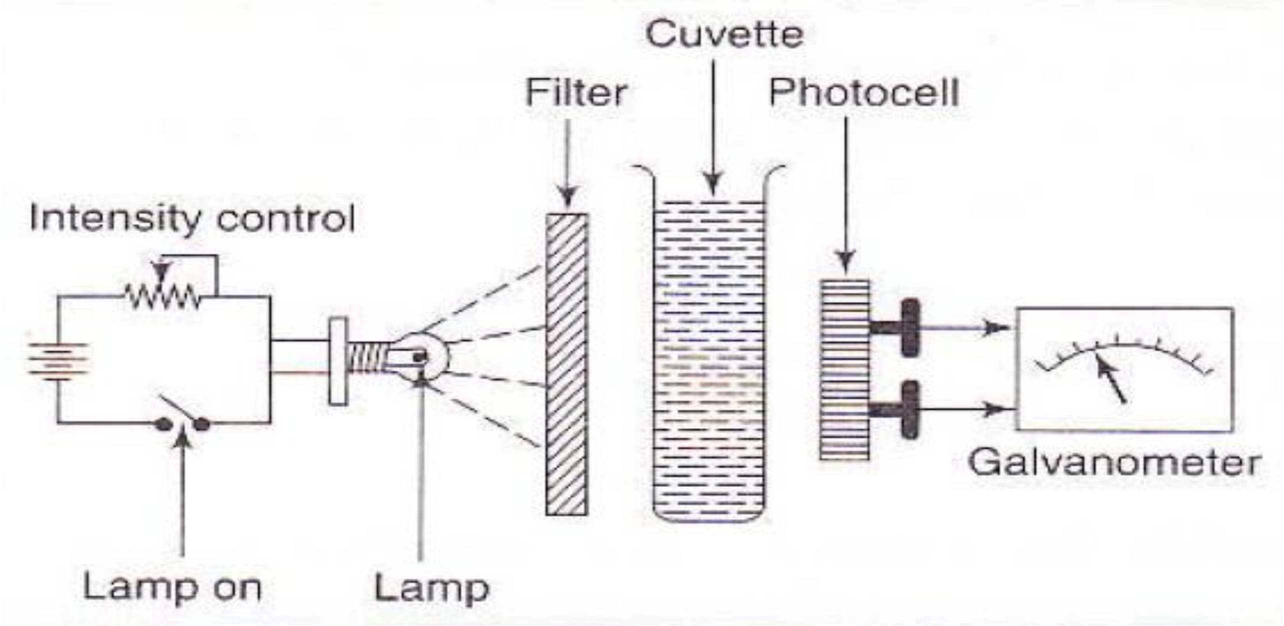
Q\ What's the different between **photometers** and **spectrophotometer**

In spectrophotometer

- The prism present beside the filter.



Basic Instrumentation of a Spectrophotometer



Photometer

How colorimeter works?

1 White light from a tungsten lamp passes through a slit, then a condenser lens, to give a parallel beam which falls on the solution under investigation contained in an absorption cell or cuvette. The cell is made of glass with the sides facing the beam cut parallel to each other.

2- Beyond the absorption cell is the filter, which is selected to allow maximum transmission of the color absorbed. If a blue solution is under examination, then red is absorbed and a red filter is selected.

NOTE: The color of the filter is complementary to the solution.

3- The light then falls on to a photocell which generates an electrical current in direct proportion to the intensity of light falling on it.

4- This small electrical signal is increased by the amplifier which passes to a galvanometer of digital readout to give absorbance reading directly.

Week 12

Beer Lambert low

Aim of Lec:

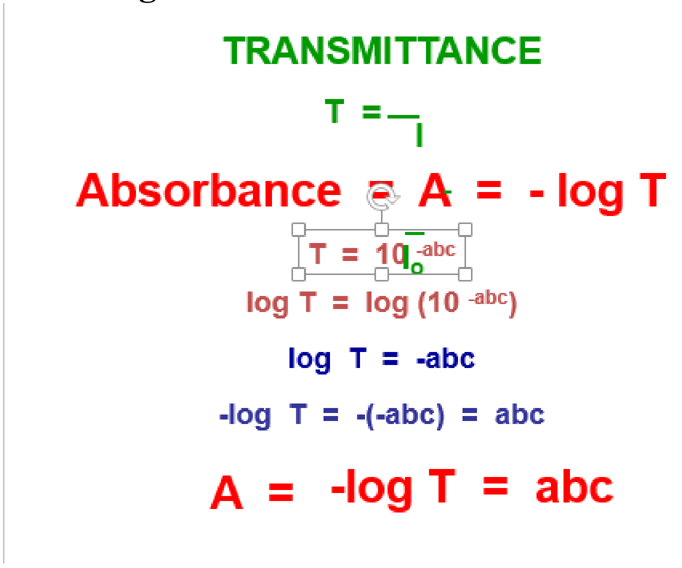
The student learns the Beer-Lambert law and uses it to relate optical absorbance to the concentration of a substance, with applications in quantitative analysis

Beer-Lambert law (or Beer's law)

- Is the linear relationship between absorbance and concentration of colored solutions . The general Beer-Lambert law is usually written as:
- A = a * b * c
- A is absorbance الامتصاص, a constant
- b is the path length, and c is concentration

Transmittance (T) for solution

- %T = percent transmittance النفاذية the ratio of transmitted light to incident light
- العلاقة بين الامتصاص و النفاذية
- log100/%T
- **A = 2- log T%**



TRANSMITTANCE

$T = \frac{I}{I_o}$

Absorbance = A = - log T

$T = 10^{-abc}$

$\log T = \log (10^{-abc})$

$\log T = -abc$

$-\log T = -(-abc) = abc$

$A = -\log T = abc$

ABSORBANCE (A)

$$A = -\log T$$

$$A = abc$$

Where:

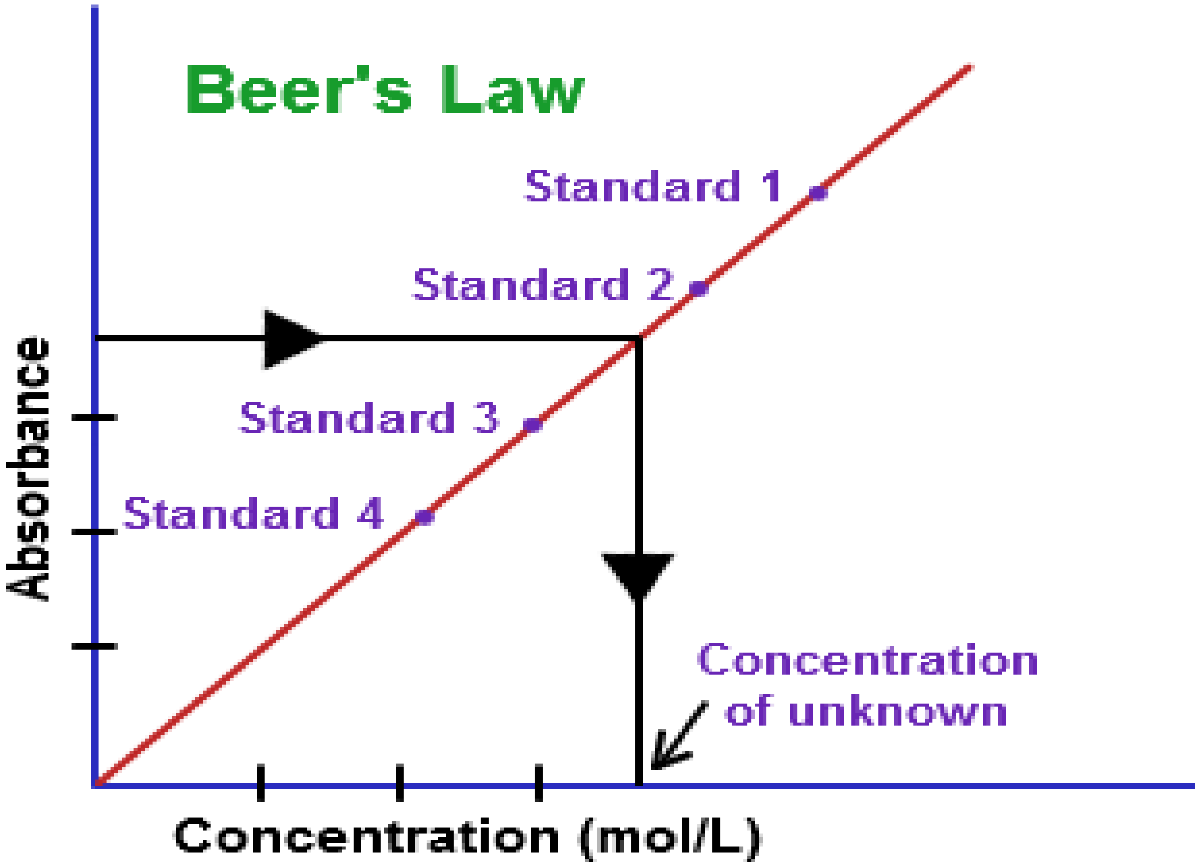
a = constant for particular solution

b = length of absorbing layer (light path length)

c = concentration of absorbing substance

Beer Lambert Law APPLY AT THIS LIMITED

- 1. colored solution only
- 2. Low con. Solution .
- 3. clear & not turbid solution
- 4. instrument must has pure mono-chromatic light.



Week 13 and 14

Instruments of colorimetry

Aim of Lec:

1. The student learns about the components of colorimetric devices, how they work, and how they are used in microchemical analysis

2. The student reviews all the theoretical concepts of the course and completes comprehensive questions in preparation for the final exams and to consolidate basic knowledge

Instruments of colorimetry

All types require a <u>Blank:</u>

which is a solution that contains the entire reagents except the substance to be measured.

It is used to adjust the device to zero.

1- Power

Turn on power.

2-Warm up

Allow about 5 minutes when first turned on.

3-Wavelength

Select appropriate wavelength.

4- Zero

With sample holder empty and closed, adjust meter needle to 0%T (or infinite A) using zero control knob.

5- Blank

Fill tube half full with water.

Place in sample holder and close cover.

Adjust meter needle to 100%T (or 0 A) using light control knob.

6- Standard (Measure absorbance (or %T) of known solution).

Fill tube half full with sample of known concentration.

Place in sample holder and close cover.

Read absorbance value (or %T) from meter.

Repeat this step if making a calibration curve or verifying proportionality (Beer's Law).

6- Standard (Measure absorbance (or %T) of known solution).

Fill tube half full with sample of known concentration.

Place in sample holder and close cover.

Read absorbance value (or %T) from meter.

Repeat this step if making a calibration curve or verifying proportionality (Beer's Law).

7- Sample

Measure absorbance (or %T) of solution with unknown concentration as in previous step.

Week 15 exam

مدة المحاضرة: 2 نظري 2 عملي

الأنشطة المستخدمة:

1. أنشطة تفاعلية صفية
2. أسئلة عصف ذهني
3. أنشطة جماعية (إذا تطلب الامر)
4. واجب بيتي
5. واجب الكتروني

أساليب التقويم:

1. التغذية الراجعة الفورية (التقويم البنائي).
2. اشراك الطلبة بالتقويم الذاتي (تصحيح اخطائهم بأنفسهم).
3. التغذية الراجعة النهائية (التقويم الختامي)، وهو حل الأسئلة المعطاة كنشاط صفي في نهاية المحاضرة.