Pharmaceutics-I

(General, Physical and Dispensing)

For the students of Pharmacy Technicians (Category-B)

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Dedication

To

Prof. Dr. Naim Anwar Muzaffar “The Father of Pharmacy”

Whose Dedications Toward Pharmacy Education Are Priceless.

Acknowledgement

I am very grateful to **Ch. Muhammad Shamoon**, Secretary, Punjab Pharmacy Council, Lahore, who give me honor to compile PHARMACEUTICS-I (General, Physical and Dispensing) Book for the students of Pharmacy Technician.

I am very thankful to my teachers **Dr. Irfan Siddique & Dr. Asim Zubair** who generously contributed their time and efforts to help me make this book as accurate and useful as possible.

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Contents

PHARMACEUTICS

Pharmaceutics is the branch of pharmacy that deals with the conversion of new chemical entity (NCE) to proper dosage form. Or

Pharmaceutics is the discipline of pharmacy that deals with the process of turning a new chemical entity (NCE) into a medication to be used safely and effectively by patients.

PHARMACIST

Any person who hold “B.Pharmacy” or “Pharm.D” (Doctor of Pharmacy) degree fro m Pakistan Pharmacy Council recognized university or college and further more he has a registration certificate from Provincial Council is known as Pharmacist. The Provincial Council enters the name of respective pharmacist in register-A.

PHARMACY TECHNICIAN

Any person that hold “Diploma in Pharmacy” from Pakistan Pharmacy Council recognized university or college and further more he has a registration certificate from Provincial Council is known as Pharmacy Technician. The Provincial Council enters the name of respective pharmacist in register-B.

According to Pharmacy Act 1967, “Pharmacist means a person who is registered under section 24 in Register-A or Register-B”.

ROLE AND RESPONSIBILITIES OF PHARMACY TECHNICIAN

A Pharmacy technician, also sometimes known as a pharmaceutical technician, is a health care worker who performs pharmacy related functions, generally working under the direct supervision of a licensed pharmacist or other health professional. Pharmacy technicians work in a variety of locations like community pharmacy, retail pharmacy, hospital pharmacy, pharmaceutical manufacturers or other health care units of government or NGOs.

Job duties include dispensing prescription drugs and other medical devices to patients and instructing on their use. They may also perform administrative duties in pharmaceutical practice, such as reviewing prescription requests with doctor's offices to ensure correct medications are provided and payment is received. In recent times, they also speak directly with the patients on the phone to aid in the awareness of taking medications on time.

PHARMACY

Pharmacy is the branch of medical science that deals with the study of discovery, development, synthesis, manufacturing action, quality assurance, distributing, regulated affairs clinical uses and marketing patterns of drugs is called pharmacy.

Pharmacy is a health profession that links “Health Sciences” with “Chemical Sciences” and aims to ensure the safe and effective use of pharmaceutical drugs.

TYPES OF PHARMACIES

There are different specialties of pharmacy as following

- **Hospital Pharmacy**
- **Clinical Pharmacy**
- **Retail or community Pharmacy**
- **Industrial Pharmacy**
- **Forensic Pharmacy**

HOSPITAL PHARMACY

Hospital pharmacy is a department or service in a hospital, responsible for the supply of medications to hospital wards as well as ambulatory patients. The pharmacist working in hospital pharmacy is known as hospital pharmacist.

AIMS & OBJECTIVES OF HOSPITAL PHARMACY

- To provide quality assurance for manufactured, assembled and purchased pharmaceutical
- To purchase and supply drugs for inpatients outpatients, hospital employees and for clinical drug trails
- Maintain patient’s medication profiles
- Maintain prescription records
- Provide drug information on drugs and drug therapy to doctors, nurses, medical and nursing students and the house staff
- Coordinate and control all drug delivery and distribution systems
- To supervise the activities of pharmacy technicians

CLINICAL PHARMACY

According to European society of clinical pharmacy

“Clinical pharmacy is the study of drugs or medicines with respect to specific diseases.” Or

Clinical Pharmacy includes all the services performed by pharmacists practicing in hospitals, community pharmacies, nursing homes, home-based care services, clinics and any other setting where medicines are prescribed and used.

The pharmacist working in the specialty of clinical pharmacy is known as clinical pharmacist and the main responsibilities of any clinical pharmacist are

- Medication review in comparison with the diagnosis
- Study about drug interaction for specific prescription
- Drug adverse reaction profiling
- Pharmacoeconomics studies
- Drug formulary

Clinical pharmacists work directly with doctors, other health professionals, and patients to ensure that the medications prescribed for patients are best for his/her treatment.

COMMUNITY PHARMACY

It is one of the pillars of pharmacy profession in this specialty we provide the pharmaceutical services at community level in the fundamental duties and goal of any community pharmacy are

- To provide quality medicine to general public
- Provide gardens and counseling regarding medication views
- Guide them regarding vaccination
- Organized health camps
- Organized health talks and seminars

Community pharmacy divided into following parts

- **Retail Pharmacy**
- **Whole Sale Pharmacy**

RETAIL PHARMACY

It is the business oriented type of pharmacy where medicines are taken from distributors or whole sellers and provided to general public on fixed percentage of profit.

WHOLE SALE PHARMACY

It is the business oriented type of pharmacy where the medicines are taken from manufacturer or distributor and provided to the medical stores pharmacies and hospitals in bulk on fixed percentage of profit.

INDUSTRIAL PHARMACY

Industrial pharmacy is the fundamental backbone of pharmacy profession it is an institution where medicines are manufactured on industrial scale. Or

Industrial pharmacy is a discipline which includes manufacturing, development, marketing and distribution of drug products.

Firstly in Pakistan the medicines are prepared manually. Due to recent scientific advances semi automatic machines replace the manual work.

VARIOUS DEPARTMENTS IN PHARMACY INDUSTRY

Pharmacy industry may have their own departments based on their requirement. A typical pharmacy industry contains following departments…

- Production Department
- Ware House
- Quality Control Department
- Research & Development Department (R&D)
- Administration Department

PRODUCTION DEPARTMENT

It is the department of pharmaceutical industries where medicines are formulated and then manufactured according to specification. Production section can be divided into following departments.

- Tablet section
- Capsule section
- Injectable section
- Syrup section

WARE HOUSE

It is an important section of any industry where raw material and finished products are stored according to their storage requirements.

QUALITY CONTROL DEPARTMENT

It is the department of pharmaceutical industry where analysis of raw material to finished products is performed to check their quality.

RESEARCH AND DEVELOPMENT DEPARTMENT

The basic function of the research and development department involves synthesis of new medicines or work on the improvement of existing medicines.

ADMINISTRATION

This section is responsible for managing all the matters of the industry e.g. administrative work, managing all records etc.

FORENSIC PHARMACY

The branch of pharmacy that deals with the study of drug, medicines laws are known as forensic pharmacy. The forensic pharmacy deals with the legal aspects of pharmacy practice the aspects on which forensic stress down are following.

- Duties and responsibilities of all government authorities.
- How to register new drug industry or institute.
- How to obtain license to manufacturer purchase and sale drugs/medicines.

DRUG

Drug is defined as, any chemical or natural substances used in investigation, diagnosis, treatment, curement or management of different diseases in humans and animals is called drug.

Classification Of Drug (On The Basis Of Sale)

1. **Over The Counter Drug (OTC)**
2. **Prescription Only Medicines (POM)**

Over the counter drug (OTC)

OTC is the group of drug that does not required any prescription for their dispensing. This group contains the following drugs

- Multi vitamin
- NSAIDS (non steroidal anti inflammatory drugs)
- Laxatives
- Some Neutraceuticals and in some European counties
- Oral contraseptics

Prescription Only Medicines (POM)

This group contains the medicine or drugs which must not dispense without prescription. This group contain following drugs

- Antibiotics
- Steroids
- Benzodiazepines
- Barbiturates
- Anti diabetics
- Anti hypertension

Classification of drugs (on the basis of their sources)

The classification of drug on the basis of their source as following

1. **Natural Sources**
2. **Semi Synthetic Sources**
3. **Synthetic Sources**

Natural Sources

Plant Sources

This is the group of drug that obtained from plants e.g.

- Reserpine is obtained from Rauwolfia serpentina
- Cinnamon aldehydes obtained from cinn amon
- Digoxin is obtained from Digitalis lanata

Animal Sources

Many animals are involved in the production of many important drugs

- Vaccines
- Insulin
- Sex hormones
- Thyroxin

Microbial Sources

This is the group of medicines/drugs that are synthesized by using different micro organisms; this group includes the following drugs

- Antibiotics
- Insulin
- Vaccines

Semi synthetic Drugs

Semi synthetic drugs are the group of drugs/medicines that are synthesized by using combined sources of natural and synthetic world

Examples

- Amoxicillin
- Cefixium
- Ceftraizone

Synthetic Drugs

Synthetic drugs are the group of drugs/medicines that are totally synthesized in laboratory by using chemicals or substances.

Examples

- Paracetamol
- Aspirin

- Ciprofloxacin
- Sulphonamide group

GENERIC NAME

These are the names of drugs that are given to them on scientific basis

Examples

- Paracetamol
- Aspirin
- Ciprofloxacin
- Levofloxacin

BRAND NAME

These are the names of medicines that are given on the proprietorship basis

Examples

- Paracetamol
- Panadol
- Dicloran
- Disprin

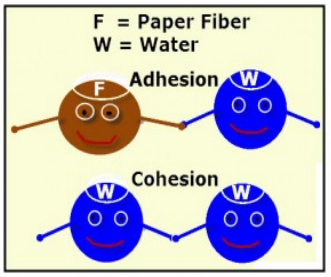
CHEMICAL NAME

These are the names which are given to the drugs on the basis of presence of different atoms or molecules and their inter-relationship

Examples

- Acetylsalicylic Acid (Aspirin)
- Acetyl Para Aminophenol (Paracetamol)

SURFACE TENSION



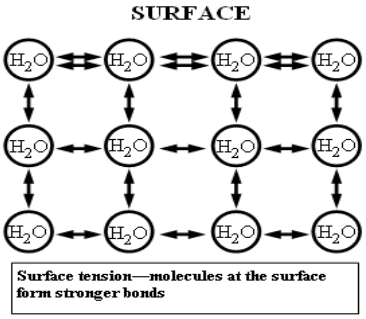
COHESIVE FORCES

Cohesive force is the force of attraction between the molecu les of the same substance.

ADHESIVE FORCES

Forces of attraction between a liquid and a solid surface are called adhesive forces

DEFINITION OF SURFACE TENSION



Surface tension is a contractive tendency of the surface of a liquid that allows it to resist an external force. The cohesive forces among liquid molecules are responsible for the phenomenon of surface tension.

Surface Tension is the reason why rain drops, drops of oil etc are spherical in shape. Surface tension also allows plants to move water (and dissolved nutrients) from their roots to their leaves,

APPLICATIONS OF SURFACE TENSION IN PHARMACY

The chemical activity, adsorption, dissolution, and bioavailability of a drug may depend on the surface of the molecule. In order to meet manufacturing challenges and develop new and better performing products with improved qualities, knowledge of surface tension is very much important.

VISCOSITY

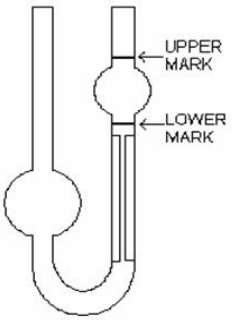
Viscosity can be described as “it is the internal resistance of the molecules of any liquid to flow called viscosity.” Or

Viscosity is the internal friction of a moving fluid. Or

Viscosity is the resistance of a liquid when it tries to flow.

Viscometer (Ostwald Viscometer)

Viscosity is measured with various types of viscometers and Rheometers. A viscometer is an instrument used to measure the viscosity of a fluid.



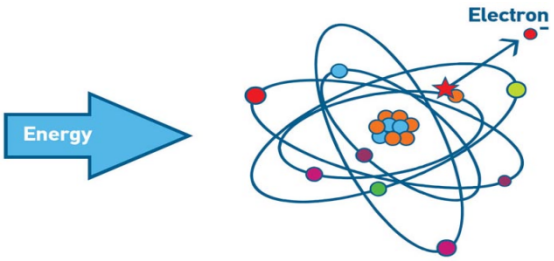
Applications in Pharmacy

Viscosity is mainly related to fluids, so in pharmacy it has many applications. It is useful in formulations of ointments, syrups, suspensions and lotions.

Viscosity enhancers (e.g. Methylcellulose, Hydroxyethylcellulose) are used in ophthalmic solutions to increase their viscosity. This enables the formulation to remain in the eye longer and gives more time for the drug to exert its therapeutic activity or undergo absorption.

Ionization

Ionization is the process by which an atom or a molecule acquires (obtain) a negative or positive charge by gaining or losing electrons. Or



The formation or separation into ions by heat, electrical discharge, radiation, or chemical reaction.

Atoms and molecules are electrically neutral in that the number of negatively charged electrons is exactly equal to the number of positively charged protons. Much of the "normal matter" that we find around us is in this form. However, particularly when there is energy sources available, atoms or molecules can gain or lose electrons and acquire a net electrical charge. This process is called ionization.

Application of Ionization in Pharmacy

Many drugs are either weak organic acids e.g. Acetylsalicylic acid (aspirin) or weak organic bases e.g. procaine, or their salts. The degree of ionization of a drug has an important effect on its absorption, distribution and elimination. So ionization is an important factor which is considered during the manufacturing process of medicines.

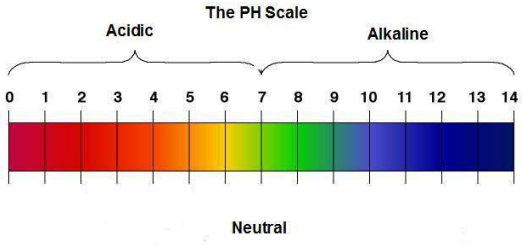
pH

pH is a unit of measure which describes the degree of acidity or alkalinity of a solution. It is measured on a scale of 0 to 14.

The term pH is derived from "p", the mathematical symbol of the negative logarithm, and "H", the chemical symbol of Hydrogen. The formal definition of pH is the negative logarithm (or negative log) of the Hydrogen ion activity.

pH = -log[H+]

Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. Pure water has a pH very close to 7 and blood has a pH 7.35.



Applications of pH in Pharmacy

It is most important to determine suitable pH for a drug. Different dosage forms e.g. eye drops, nasal drops, ear drops, oral solutions; injectables should be of appropriate pH.

pH Indicators

A pH indicator is a chemical compound that is added in small amounts to a solution so that the pH (acidity or alkalinity) of the solution can be determined easily.

The aims to use pH indicators are

- To determine the type of compound
- To determine the pH of different sample
- To verify the presence of any chemical substance

Types of pH Indicators

There are three fundamental types of indicators

1. **Acid Base Indicators**
2. **Redox Indicators**
3. **Ppt Indicators**

Acid Base Indicator

These are the indicators that change their color as we change the pH of the solution

Example

- Methyl orange
- Phenolphthalein

REDOX INDICATOR (OXIDATION-REDUCTION INDICATOR)

These are the compounds that change their colors during oxidation and Reduction reaction.

Example

There are two common types of redox indicators

- Metal-organic complexes (Ex. phenanthroline)
- True organic redox systems (Ex. Methylene blue)

PRECIPITATION INDICATOR

Those indicators that change their color during precipitation reaction are called precipitation indicators, e.g. Phenol Red. (Precipitation = the action or process of falling, collecting or condensing of a substance on the ground from a solution).

APPLICATIONS OF pH INDICATORS IN PHARMACY

pH indicators are used in titrations in analytical chemistry and biology to determine the pH of different substances.

(Titration = The process of determining the concentration of a unknown solution by adding it into known concentration solution until a color change and then calculating the unknown concentration of solution. Or

A titration is a technique in which a solution of known concentration is used to determine the concentration of an unknown solution.)

BUFFER

Buffer is the compound or mixture of compounds that resist to changing pH of any solution on slight addition of acidic or basics solution or compound.

APPLICATIONS OF BUFFER IN PHARMACY

Buffers are most widely used in biological industry to preserve the pH of biological compounds and fluids.

In manufacturing of injection and other dosage forms, buffer are used to maintain their pH.

Buffers are used in fermentation process.

ISOTONIC SOLUTIONS

SOLUTION

In pharmaceutical terms, solutions are “liquid preparations that contain one or more chemical substances dissolved in a suitable solvent or mixture of mutually miscible solvents”.

Or, Solutions are homogeneous liquid preparations that contain one or more chemical substances (solute) dissolved in a suitable solvent or mixture of mutually miscible solvents.

SOLVENT

Solvent is the liquid portion of a solution in which another substance (e.g. salt) is dissolved to form a solution is called solvent.

SOLUTE

A substance that is dissolved in another substance (solvent) to form a solution is called solute. Or

A solute is a substance that creates a solution when dissolved by a solvent. Solute can change its physical state, e.g. salt is solid before getting dissolved in water, and after dissolution it changes from solid to liquid.

DEFINITION OF ISOTONIC SOLUTION

In medical sciences, isotonic solution is a solution that has the same salt concentration as to the normal cells of the body and the blood.

In the general sense, two solutions are isotonic when they contain the same amount of solutes, or dissolved substances.

Examples of isotonic solutions are dextrose 5% in water, Ringer's solution, and normal saline solution (0.9% w/v sodium chloride solution)

HYPERTONIC SOLUTION

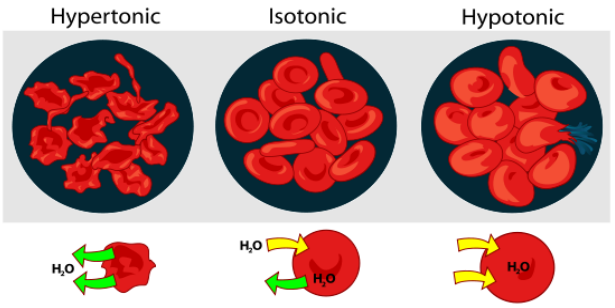
Hypertonic solution is one with a higher concentration of solutes outside the cell than inside the cell. When a cell is dip into a hypertonic solution, water will move outside from the cell in order to balance the concentration of the solutes.

HYPOTONIC SOLUTION

Hypotonic solution has a lower concentration of solutes outside the cell than inside the cell.
When a cell is dip into a hypotonic solution, water will move into the cell to balance the concentrations of solutes inside and outside the cell, causing it to swell and possibly burst.

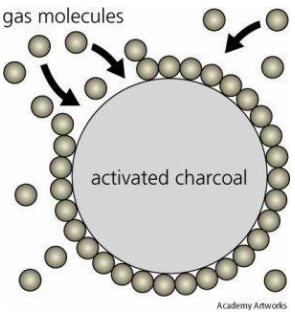
Applications of Isotonic Solution in Pharmacy

- Isotonic solutions are used in physiological experiments and tissue culture
- Isotonic solutions are used to balance the electrolytes
- Isotonic solutions are used to maintain the physiological conditions
- For medical purpose isotonic solution (normal saline) is used to flush wounds
- Normal saline is also used I.V for patients who cannot take fluids orally
- Saline is also used for nasal washes to relieve some of the symptoms of the common cold



Adsorption

Adsorption is a surface phenomenon in which molecules of a substance such as gas or liquid collect on the surface of another substance such as solid is called adsorption. Or



The condensation or adhesion of a gas, vapor, liquid or dissolved substances on the surface of a solid or liquid is called adsorption.

Types of adsorption

Adsorption fundamentally divided into two main categories

1. **Physical Adsorption**
2. **Chemical Adsorption**

Physical Adsorption

It is the interaction of liquid or gas particles with solid particles surface and physical characteristics are involved in it.

Example

Many drugs are absorbed from GIT and skin through physical adsorption mechanism

Chemical Adsorption

It is the process in which liquid or gas particle binds to solid particle surface through chemical reaction is known as chemical adsorption.

Example

Accumulation of O2 on the surface of iron (rust)

Application of Adsorption in Pharmacy

- Adsorption is the mechanism of absorption through skin and GIT
- Adsorption is the fundamental mechanism of antidotes
- In the preparation of gas masks using activated charcoal to avoid poisonous gases
- Silica gel can be used to remove moisture and to control humidity
- Adsorption chromatography is used to purify and separate pigments, hormones etc
- It is the main mechanism to compact with intestinal toxin

Calcinations

Calcinations is the process in which the inorganic matters are strongly heated they will loose their volatile component and fixed component are preserved. Or

To heat a substance to a high temperature but below the melting or fusing point, until they loss their moisture or volatile components is called calcinations process.

Application of Calcinations in Pharmacy

- A lot of chemicals are obtained by calcinations, such as pigments
- Calcinations process is used to get the fixed components of a substance
- Calcinations is used in the separation and purification of Calcium Oxide, Zine oxide

CENTRIFUGATION

Centrifugation is a process that involves the use of the centrifugal force for the sedimentation of mixtures with a centrifuge (A centrifuge is electrical equipment that rotates an object in a fixed axis results in sedimentation of mixtures). Or

The process in which Solids are separated from liquids by the centrifugal force or rotation is called centrifugation.

(An object traveling in a circle behaves as if it is experiencing an outward force. This force, known as the centrifugal force)

APPLICATION OF CENTRIFUGATION IN PHARMACY

- A centrifuge is also used to separate the components of blood in blood banks
- Removing fat from milk to produce skimmed milk
- The clarification and stabilization of wine
- Separation of urine components and blood components in forensic and research labs

CRYSTALLIZATION

A method which is used to convert liquid into solids by using evaporation, cooling or precipitation is known as crystallization. Or

Crystallization is the (natural or artificial) process of formation of solid crystals

METHOD OF CRYSTALLIZATION

There are three methods of crystallization

1. **Evaporation Method of Crystallization**
2. **Cooling Method of Crystallization**
3. **Precipitation Method of Crystallization**

EVAPORATION METHOD OF CRYSTALLIZATION

In this method the temperature of the liquid raised and the liquid evaporate, so finally we get a solid crystals of compounds.

Cooling Method of Crystallization

In this method we use cooling procedure to form solid crystals. It is a very selective method used only for heat sensitive materials.

Precipitation Method of Crystallization

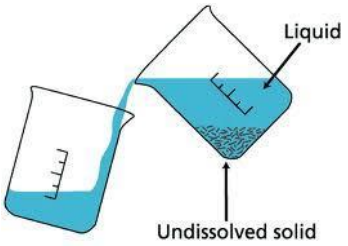
In this method the liquid is converted into precipitates and then separate out the solid material. it is very rarely used method of crystallization.

Application of crystallization in Pharmacy

- It is important purification mechanism used in pharmaceutical industries to get pure solid drugs
- Penicillin-G is solidify by this process
- Crystallization process is used to get proteinaceous drugs in solid form
- Due to crystallization the stability of product Is enhance
- Crystallization is used for purification purpose

Decantation

Probably the simplest method of separating solids from liquids is the process of decantation, which simply means letting the solids settle to the bottom of the container and pouring off the liquid. Or



It is a process used in pharmacy to separate out the impurities from the soluble portion of the solution. Or

Decanting is the careful process of pouring (flow) liquid from one container to another, usually leaving behind sediment.

Application of Decantation in Pharmacy

- A mixture of two immiscible liquids can also be separated by decantation
- This method is used to purify the solids
- This process is also used to separate the solids from liquids
- It is also used in the separation of gels and magmas

DELIQUESCENCE

The process by which a substance absorbs moisture from the atmosphere until it dissolves in the absorbed water and forms a solution. Or

It is chemical process in which any anhydrous compound (compound containing no water) catches up the water from its surrounding environment and converts itself into hydrated (containing water) form.

Note: (difference between deliquescent material and hygroscopic material)

Deliquescent material absorbs water from air enough to form solutions e.g. calcium chloride, magnesium chloride, zinc chloride

Hygroscopic material absorbs water from air but not enough to form solutions e.g. Sugar, Sodium chloride, Silica gel

APPLICATION OF DELIQUESCENCE IN PHARMACY

- Deliquescence compounds are used to remove the water produced by chemical reactions.
- These substances are used to preserve different pharmaceuticals.

DESICCATION

It is drying procedure which is widely used in pharmacy to remove the water from the product. Or

Desiccation is the state of extreme dryness, or the process of extreme drying.

DESICCATORS

A desiccator is a heavy glass or plastic container used in practical chemistry for keeping small amounts of materials to dry. The material is placed on a shelf, and a drying agent or desiccant, such as dry silica gel is placed below the shelf.

APPLICATION OF DESICCATION IN PHARMACY

- By using Desiccation the stability of pharmaceutical product enhances
- Desiccation is a famous process of drying
- All the hygroscopic drugs are dried through Desiccation process
- For Desiccation dried silica gel is used in the bottles of hygroscopic medicine

DISTILLATION

It is the method which is used to separate different chemical substances on the basis of their volatilities. Or

It is a purification as well as separation process in which a chemical substance is boiled up to their boiling point until it converts into vapors then the condenser is attached the distillation flask which condensed back these vapors into liquid again. Or

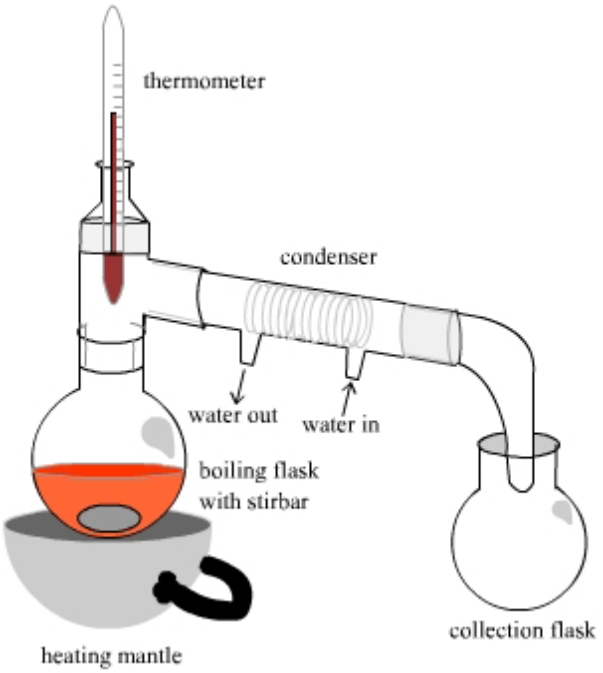
Distillation is a commonly used method for purifying liquids and separating mixtures of liquids into their individual components.

TYPES OF LABORATORIES BASED DISTILLATION

- **Simple Distillation**
- **Fractional Distillation**
- **Steam Distillation**
- **Vacuum Distillation**

SIMPLE DISTILLATION

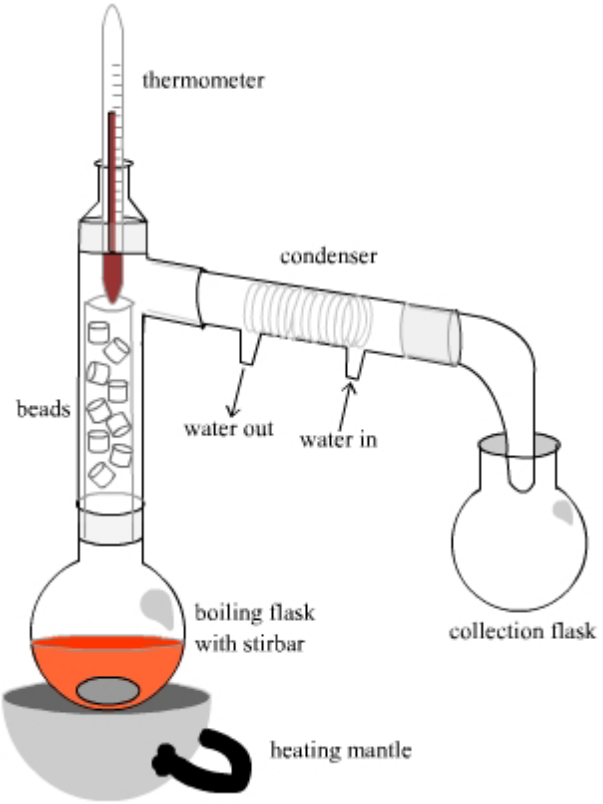
Simple distillation is a process used to eliminate solid impurities from a liquid. Or



Simple distillation is the process used to purify liquids by bringing them to their boiling point, and then collecting and condensing back their vapors into liquid.

FRACTIONAL DISTILLATION

Fractional Distillation is a process by which components in a chemical mixture are separated



according to their different boiling points.

In fractional distillation the compound is heated and, as each of its constituent components comes to a boil, its vapors are separated and cooled, so it can be removed in its pure form.

STEAM DISTILLATION

Steam distillation is purification and separation process which is used for water immiscible compounds and water should be present in the system. It is used for temperature sensitive materials.

Steam distillation is used for the distillation of two immiscible liquids one of which is water. An immiscible liquid and water independently boils at high temperature but when steam is passed through a mixture of these liquids, they boil at a much lower temperature than the boiling point of pure water.

VACUUM DISTILLATION

Vacuum distillation *is used for compounds that have high boiling points. The vacuum is provided either by a* water aspirator (A device for removing liquids or gases by suction) or by a mechanical pump.

Vacuum distillation works on the principle that a liquid boils when its vapor pressure is equal to the atmospheric pressure or external pressure. From this it is clear that the liquids which are

decomposed at their boiling point under atmospheric pressure can be distilled at a much lower temperature than its boiling point if the pressure is reduced on the surface of the liquid.

Applications of Distillation in Pharmacy

- Distillation process is used to purify liquids
- Water can be purified by distillation process
- Distillation process is used for purification of volatile substances
- It is also used for the extraction of volatile oils from their crude drugs
- Distillation is used to extract perfume or aromatic liquids from plants
- Simple distillation is used in the preparation of sprit, alcohol, ether etc
- Steam distillation is used for the distillation of water immiscible liquids of high boiling points

Efflorescence

Spontaneous (sudden) loss of water by a hydrated salt is called Efflorescence. Or

Efflorescence is the loss of “water of crystallization” (water that present inside crystals) from a hydrated salt to the atmosphere on exposure to air.

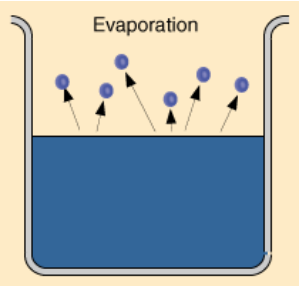
Elutriation

Elutriation is a process of separating particles, based on their size, shape and density, using a stream of gas or liquid flowing in a direction usually opposite to the direction of sedimentation. It is used in mineral processing for size classification. Or

Elutriation is a materials separation method in which smaller and larger materials are separated by using the liquid or gas.

Vaporization

Conversion of a substance from the liquid phase into the gaseous (vapor) phase is called vaporization. Or



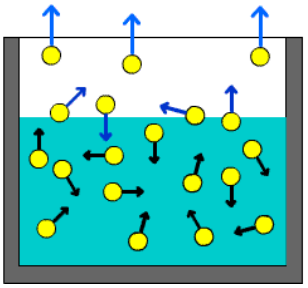
Vaporization is the process by which a liquid is turned into a gas.
(Direct conversion from solid to vapor is called sublimation)

There are two types of vaporization

1. **Evaporation**
2. **Boiling**

Evaporation

Evaporation is a type of vaporization of a liquid that occurs only on the surface of a liquid. During Evaporation, liquids changes to gas on the surface of the liquid at below the boiling temperature.



Boiling

Boiling refers to heating up a liquid until it releases vapor. During Boiling, the liquid changes to gas form above the boiling temperature and occurs below the surface of the liquid.

Exsiccations

The process of removing water of crystallization from crystalline salt or rendering crystalline salts anhydrous is called exsiccation.

Fusion

Fusion is the process of heating the solid until it melts.

Applications of Fusion in Pharmacy

- Fusion is used in making ointments, creams, lotions, and suppositories
- It is used in pharmacy for mixing procedure

Ignition

Ignition is a process used in pharmacy in which the chemical substances are strongly heated until its carboneous part burn and its inorganic residues left in the form of ash.

Applications of Ignition in Pharmacy

- Ignition process is used as a standardization test to evaluate the quality and purity of organic compounds
- Ignition is also used as sterilization process
- It can be used in separate inorganic substances

LEVIGATION

Levigation is the process of grinding or mixing an insoluble substance to a fine powder while wet.

APPLICATIONS OF LEVIGATION IN PHARMACY

- It is the leading method that is used in dispensing pharmacy to mix up the medicaments with the fat or water soluble base.
- Levigation process can be used in the formulation of ointments, creams, paste and gels.
- Levigation can also be used to form granules of different mixture of API.

LYOPHILIZATION (FREEZE-DRYING)

Lyophilization is a process which extracts the water from foods and other products so that the foods or products remain stable and are easier to store at room temperature. Or

Lyophilization is a dehydration process typically used to preserve a material.

Lyophilization is carried out using a simple principle of physics called sublimation. Sublimation is the process in which solid converts directly into vapor state without first passing through an intermediate liquid phase.

To extract water, the process of lyophilization consists of

- Freezing the food so that the water in the food becomes ice
- Under a vacuum, sublimating the ice directly into water vapors
- Drawing off the water vapors
- Once the ice is sublimated, the foods are freeze-dried

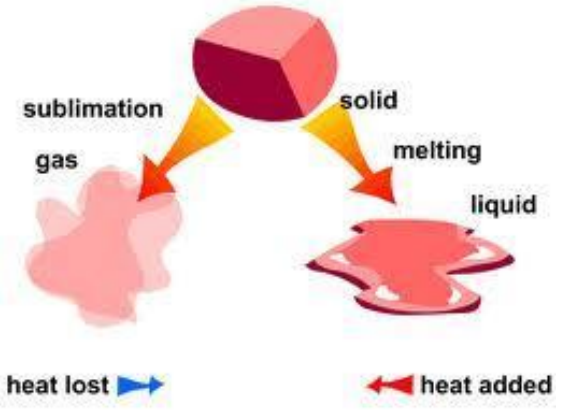
Application of Lyophilization (Freeze-drying) in Pharmacy

Pharmaceutical companies often use freeze-drying to increase the shelf life of the products, such as vaccines and other injectables. By removing the water from the material and sealing the material in a vial, the material can be easily preserved, stored and shipped.

Sublimation

The process of changing from a solid to a gas without passing through an intermediate liquid phase.

Sublimation is a technique used by chemists to purify compounds. Dry ice is solid carbon dioxide. At room temperature and pressure, it sublimates into carbon dioxide vapor. Sublimation is used to



create freeze-dried substances.

Trituration

It is a process of comunication in which we use pestle and mortar to reduce the particle size of

given substances.

(Comminution is the reduction of solid materials by crushing, grinding, and other processes)

Applications of Trituration in Pharmacy

- Trituration is used to reduce the size of different substances
- Trituration is used for the mixing of different pharmaceutical components
- Trituration is used in the formation of creams, lotion and ointments
- Trituration is used in the dispensing of different drugs

HISTORY OF PHARMACY

Pharmacy is a word derived from a Greek word “Pharmakon” which means drug or medicine.

Interest in medicines has been almost universal and constant since the beginning of man. The Muslim scientists play a significant role in the discovery, development, formulation, manufacturing and the use of drugs in according with the specific diseases.

CONTRIBUTION OF MUSLIM SCIENTIST IN PHARMACY

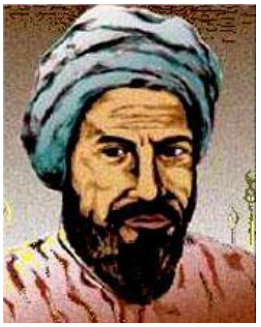
AL-KINDI (801-873 A.D)

Al-Kindi was a great Muslim philosopher; scientist, physician and psychologist. He played a significant role in the development of many branches of science e.g. Pharmaceutical chemistry, medicine, psychology and cosmetics.

His notable work include

- Al kindi was first person who used music for the treatment of Psychological problems
- He describes the isolation (separation) process of alcohol to form pure wine
- He describes in detail regarding cosmetics formulation
- He describes the epilepsy
- He described how to make perfumes

IBN-AL-NAFIS (1213-1288 A.D)



Ibn-al-Nafis was the one of the greatest physician Anatomist, Physiologist, Sociologist, Pharmacologist and Islamic scholar of his time. He was renowned for the following work.

- He was first person who described the pulmonary circulation, capillary and coronary circulation.
- He described in detail the anatomy and physiology of respiratory system, genitourinary system and GIT.
- He was the first person who writes about pulse rate.
- He has worked in the development of over 100 drugs.

IBN-ZUHAR (1091-1161 A.D)

Ibn-Zuhar was the great Muslim scholar, physician, pharmacist and surgeon. His scientific work includes…

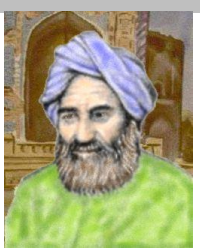
- He was the first pe rson who describes experimental surgery so he was considering being the father of experimental surgery.
- He firstly describes the procedure for dissection.
- He done remarkable work and contribution to subject neuropharmacology.
- Ibn-Zuhar was that first person who describe the use of inhaled anesthetics so he was consider to be the pioneer of modern anesthesiology.

ABU ALI SINA (980-1037 A.D)

Abu Ali Sina was a great physician, chemist and astronomer of his time. His book “The cannon of medicine” was used a text book of medicine for many years. His most famous scientific work includes.

- He was the person who firstly describes steam distillation.
- He firstly describes the procedure of diagnosis.
- He was the person who describe the different psychiatric diseases e.g. Depression, Mania, Insomnia, etc. in detail.
- He was the first person who describe the paralysis in detail

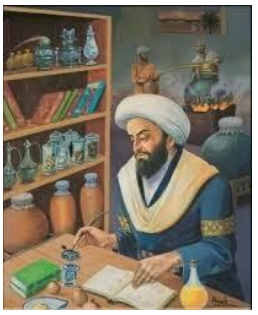
AL- BIRONI (973-1050)



Al –Bironi was a great pharmacist, physician and Geologist. His famous scientific works includes.

- He works in the development and progress of pharmacy field.
- He wrote a book “Al-Saddana fil tibb” which has description of more 720 herbal drugs and these are arranged alphabetically.
- He also describe regarding the active constituents of drugs.

JABER BIN HAYAN (721-815)



Jaber Bin Hayan was one of the greatest scientist chemist and Geologist of his time. He was born in Iran. He was the first scientist who introduced experimentation in chemistry. His greatest scientific work includes…

- He was the person who first time introduce the practical importance of chemistry which than lead to the era of industrialization.
- He invented more than 20 laboratory equipments.
- He firstly describes distillation and crystallization.
- He discover many chemical substance e.g. Nitric acid, hydrochloric acid, Acetic acid
- He describes the purification process of gold.

BOOK IN PHARMACY

There are fundamentally two types of books in pharmacy

1. **Official Books**
2. **Non Official Books**

Official Book

These are the books that are written, compiled and published under the strict supervision of Government agency is known as official book

Important Official Books are

- **United State Pharmacopoeia (USP)**
- **British Pharmacopoeia (BP)**
- **International Pharmacopoeia (IP)**
- **United States National Formulary**
- **British National Formulary (BNF)**

(Pharmacopoeia = an official publication containing a list of medicinal drugs with their effects and directions for their use)

(Formulary = 'formulary' is a list of medicines. Formulary contained a collection of formulas for the compounding and testing of medication)

Non Official Book

These are the books that are written, compiled and published locally and there is no role of any Government Agency in there publication known as non-official books.

Example

Remington Pharmaceutical sciences

Some Important Official Books

United State Pharmacopoeia (USP)

This is an official book of pharmacy. It is one of the leading and important pharmacopoeia of the world that is in used. USP firstly written compiled and published under the supervision of a government agency of United States named “United State Pharmaceuticals Convention”.

Mainly USP is used to determine the strength, quality, quantity, purity and labeling of drug.

United State National Formulary (UNF)

In 1888 the first National Formulary of united state was published under the supervision of American Pharmaceutical Association But in 1974 the right of UNF was given to “United State Pharmaceutical Convention” so from 1980 the UNF is published with USP-NF is used.

Mainly UNF contain following information

- Standards for medicines
- Dosage forms
- Drug substances
- Excipients
- Medical devices
- Dietary supplements

International Pharmacopoeia (IP)

International pharmacopoeia is the official book that has been written, published and compiled by the WHO (World Health Organization).

The World Health Organization (WHO) is a specialized agency of the United Nations (UN) that is concerned with international public health.

Mainly IP contain following information

- Pharmaceutical technological techniques for the development of drugs.
- Drug formulation and manufacturing processes
- Controlling the quality of medicines

British Pharmacopoeia (BP)

British Pharmacopoeia is the most abundantly used pharmacopoeia in the world today. It is mostly used because of their up to date monograph (monograph = a specialist work of writing on a single subject usually by a single author) regarding the drug.

This book contain the following data

- Monograph of drugs.
- Quality control and quality assurance of pharmaceutical production sections of pharmaceutical industries.
- Quality control test of dosage forms
- Identification and analytical test of drugs

British Nation Formulary (BNF)

It is the national formulary of medicines that are being used in United Kingdom. This book is largely used as a text book for registration examination in UAE and in UK.

This book contain following information

- Detail knowledge regarding the clinical and pharmacological aspects of drugs/ medicines
- Detail note on prescription policy
- Knowledge regarding the refilling and patient handling

Some Common Non-Official Books

These are the books that are written, compiled and published locally and there is no role of any Government Agency in there publication known as non-official books.

Common non-official books

1. **Remington Pharmaceuticals Sciences**
2. **Applied and Clinical pharmacology by Katzung**
3. **Tutorial Pharmacy**

Remington Pharmaceuticals Science

This book contains a detail knowledge regarding all the aspects of pharmacy.

Applied and Clinical Pharmacology by Katzung

This book contain a detail knowledge regarding drug and their actions on humans

Tutorial Pharmacy

This book contains a detail knowledge regarding the physical pharmacy.

Dosage Forms

Drug Delivery System

It is administration of drug or medicine to the living system for treatment, curement, management or prophylaxis of disease (treatment given or action taken to prevent disease e.g. before the disease). Or

Drug delivery systems can be defined as mechanisms to introduce therapeutic agents into the living system (human or animal body).

Dosage Form

Any Pharmaceutical product which is ready for the use of patient is known as dosage form. Or

Any pharmaceutical product which has defined shape and have prescribed amount of APIs (active pharmaceutical ingredient) is called a dosage form.

Dosage forms are classified according to

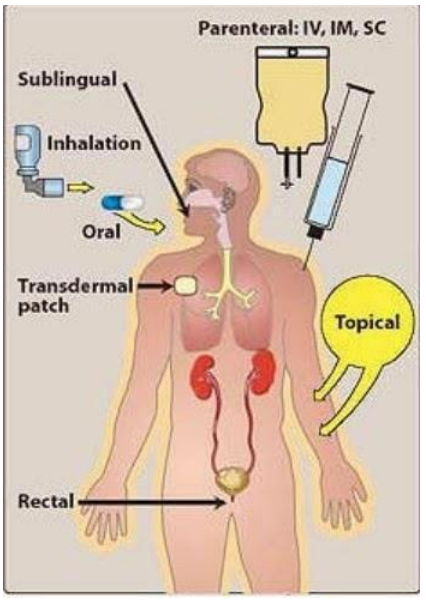
- **Route of Administration**
- **Physical Form**

Dosage Form According to the Route of Administration

Depending on the method/route of administration, dosage forms come in several types.

For example

- **Oral**
- **Inhalational**
- **Parenteral**
- **Topical**
- **Suppository**



Oral

Medications that are taken by mouth are called oral dosage form

- Tablet or capsule
- Liquid solution or suspension (e.g., drink or syrup)
- Powder or liquid or solid crystals

INHALATIONAL

Medications that are delivered through the nose or inhaled and are absorbed through the nasal mucosa or bronchioles respectively are called inhalational dosage form.

- Aerosol
- Inhaler
- Nebulizer
- Smoking
- Vaporizer

PARENTERAL

Medications that are administered by injecting a drug directly into a vein (intravenous), muscle (intramuscular), or fatty tissue beneath the skin (subcutaneous) etc. are called parenteral dosage form.

- Intradermal (ID)
- Intramuscular (IM)
- Intravenous (IV)
- Subcutaneous (SC)

TOPICAL

Medications that are applied on the surfaces of the body, especially the skin or mucous membranes are called topical dosage form, ophthalmic and otic preparations are also topical medications.

- Cream, gel, liniment or balm, lotion, or ointment
- Ear drops (otic = relating to the ear)
- Eye drops (ophthalmic = relating to eye)
- Skin patch (transdermal = relating to skin)

ENTERAL OR SUPPOSITORY

Medications that are administered into the rectum or virginal and absorbed by the lower digestive tract are called Enteral dosage form.

- Vaginal
- Rectal

DOSAGE FORM ACCORDING TO THE PHYSICAL FORM

1. **Solid Dosage Form**
2. **Semisolid Dosage Form**
3. **Liquid Dosage Form**

SOLID DOSAGE FORM

- Tablet
- Capsule
- Granules
- Powder

SEMISOLID DOSAGE FORM

- Ointment
- Creams
- Paste
- Lotion
- Gel

LIQUID DOSAGE FORM

- Syrup
- Tincture
- Suspension
- Emulsion
- Injectables
- Drops (eye & ear)
- Oral solution
- Elixir
- Oral drops
- Mouthwashes

Introduction of Different type of Dosage Form

Tablets

Tablets are compressed unit solid dosage form made up of medicinal agent (active substances) with the aid of suitable pharmaceutical excipients (inactive substances) for oral, buccal (relating to the cheeks or mouth) vaginal or rectal route of administration.

Advantage of Tablets

- Ease of administration
- Surety of accurate dose
- In tablet manufacturing we have the ability of mask the taste of tablets
- Different colors of tablets are more attractive to patient and easy to identification.

Disadvantage of Tablets

- Tablets manufacturing is very expensive method
- Not suitable for children and unconscious patients

Different Types of Tablets

Compressed Tablets

These are the tablets that are made up of single compression and medicinal agent in addition with lubricant binder, distintegrent, diluents, colorant and flavoring agent are used, e.g. Paracetamol, Aspirin Tablets.

Multiple Compressed Tablets

These are the tablets that are manufactured by multiple compressions.

- By joining two or more tablets
- Tablet with in a tablet

Film Coated Tablets

These are the tablets which are coated by film coating materials e.g. Augmentin.

Sugar coated tablets

These are the tablets that are coated by the sugar syrup intended to mask the bitter taste of tablets e.g. Brufen.

Sublingual Tablets

These are the tablets that are used sublingually (under the tongue) e.g. Angised (nitroglycin)

Effervescent Tablets

These are the tablets that on dissolving in water produce effervescence (bubbles in a liquid, escape of gas) e.g. Disprin, Cac 1000. Or

Effervescent or carbon tablets are tablets which are designed to break in contact with water or another liquid, releasing carbon dioxide in the process.

Enteric Coated Tablets

These are the tablets that are coated by such kind of materials that resist the action of acids in stomach e.g. Loprin, Voltaren, Ascard

Lozenges

Lozenges are the tables intended to be dissolved slowly in the mouth e.g. Strepsils, Difflam

Implants (pellets)

A small tablet that is prepared for insertion under the skin by giving a small surgical cut into the skin which is stitched after the insertion of tablets.

Chewable Tablets

The tablets are placed in the mouth, chewed and swallowed.

Capsules

Capsules are unit solid dosage form in which the medicaments are enclosed in a soluble shell of gelatin, starch or similar material and intended to be swallowed whole orally. Or

Capsules are gelatin shells used to fill a unit dose of powdered and mixed ingredients of a prescription.

Composition of Gelatin

Gelatin USP is a product obtained by the partial hydrolysis of collagen (protein of fibrous connective tissue), obtained from skin, white connective tissue and bones of animals.

Advantage of Capsules

- Capsules may be used for dispensing solid, semisolid drugs.

- Easy to swallow.
- It is very attractive dosage form.
- The efficacy of many drugs increases in the form of capsules
- Capsules mask the unpleasant taste of its contents.
- Disintegration is very reliable in capsule formation.
- Capsules can be colored to avoid from direct sun rays.

DISADVANTAGE OF CAPSULE

- Capsules are expensive than tablets.
- Capsules cannot be used in aqueous or alcoholic preparation.
- Hygroscopic (any substance that can absorb moisture from the air) substances cannot be capsulate

TYPE OF CAPSULES

There are two fundamental types of capsules

1. **Soft Gelatin Capsules**
2. **Hard Gelatin Capsules**

SOFT GELATIN CAPSULE

Soft gelatin capsules primarily used for oils and for active ingredients that are dissolved or suspended in oil.

Soft Gelatin Capsule have the soft gelatin shall around its medicaments. Soft gelatin can be made up by gelatin in which, Glycerin or Sorbitol has been added to make it elastic or plastic like.

Soft gelatin capsules are fond in different shapes e.g.

- Oval
- Tube shape
- Round

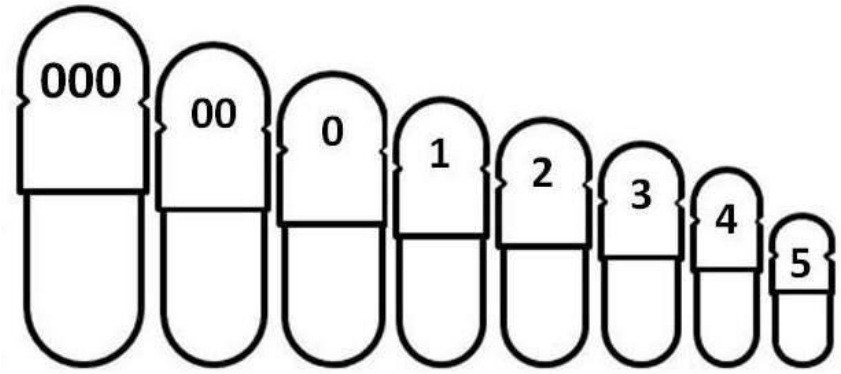
HARD GELATIN CAPSULES

Hard gelatin capsules are normally used for dry powdered ingredients. These are the capsules that have hard shall of gelatin around its medicaments.
Hard gelatin can be prepared by gelatin, containing sugar and water in appropriate quantity.

There are two parts of hard Gelatin Capsules

1. Cap
2. Body

Human medicines are manufactured in eight size of capsule.



As a guide, the relative sizes and fill capacities of capsules with Aspirin are given below.

Capsule Size	Aspirin (Mg)
000	1000
00	600
0	500
1	300
2	250
3	200
4	125
5	60

SYRUPS

Syrups are concentrated aqueous preparation of sugar or sugar substitute with or without flavoring and medicinal agent.

TYPES OF SYRUPS

- **Simple Syrup**
- **Flavored Syrup**
- **Medicated Syrup**

SIMPLE SYRUP

Simple syrups are concentrated solutions of sugar such as sucrose in water. Or

When purified water alone is used in making the solution of sucrose, the preparation is known as simple syrup.

According to B.P specifications, simple syrup contains 66.7% w/w of sucrose as the solute in 33.3% w/w of water as the solvent.

Sugar is mainly used to:

- Preserve the finished product
- Aid in masking the unpleasant taste of the active ingredient(s)
- Enhance the flavor

FLAVORED SYRUPS

Flavored syrups are made by adding flavoring matter to simple syrup, e.g. orange flavor or cinnamon water into simple syrup.

MEDICATED SYRUPS

Medicated syrups are aqueous solutions containing sugar and at least one water soluble active ingredient.

ELIXIRS

Elixirs are clear sweetened hydro alcoholic solution intended for oral use. Usually they are flavored to enhance taste.

Elixirs often require dilution before use or administration. These are stable as compare to mixtures.

Types of Elixirs

- Medicated elixirs
- Non-medicated elixirs

Medicated Elixirs

Medicated elixirs contain at least one active ingredient

Non-medicated Eelixirs

Non-medicated elixirs do not contain any drug. They are used as solvents or vehicles for the preparation of medicated elixirs. They also used as flavoring agents.

Aerosols

Aerosols are not a dosage form but dosage system. Pharmaceutical aerosols are dosage systems containing one or more active ingredient which upon activation, emit a fine dispersion of fine solid particles or liquid droplets in a gaseous medium.

Types of Aerosols

- Nebulizer
- Meter dose Inhalers (HFA)
- Dry powder Inhalers

Nebulizer

A nebulizer is a drug delivery device used to administer medication in the form of a mist (a cloud of tiny water droplets) inhaled into the lungs.

Meter dose Inhalers (MDI)

A metered-dose inhaler (MDI) is a device that delivers a specific amount of medication to the lungs. it is usually self-administered by the patient via inhalation. It is the most commonly used delivery system for treating asthma.

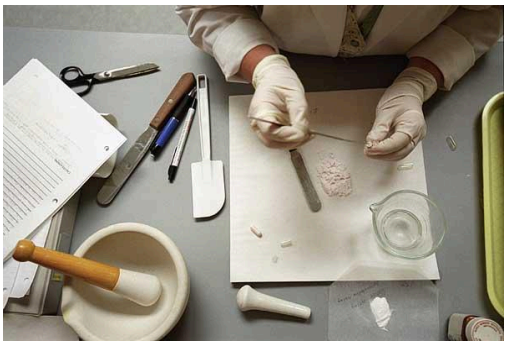
DRY POWDER INHALERS (DPI)

A dry powder inhaler (DPI) is a device that delivers medication to the lungs in the form of a dry powder. DPIs are commonly used to treat respiratory diseases such as asthma.

DISPENSING & COMPOUNDING

COMPOUNDING

It is specialized process to change dosage form (e.g. solid to liquid) and includes the preparation, mixing, packaging or labeling of a drug in response to a prescription written by a licensed



practitioner according to the need of a patient.

DISPENSING

Dispensing is a pharmacy act and consists of the removal of two or more doses from a bulk drug container and placing them in another container/ envelop for later use by a patient. Or

Dispensing is concerned with the preparation and supply of medicines.

BASIC PRINCIPLES OF COMPOUNDING AND DISPENSING

Today, most dosage forms of medications are already pre-packaged by the manufacturer and thus the Pharmacist role is more in the redistribution of medications and the clinical aspect of Pharmaceutical Care.

However the basic principles of compounding and dispensing are very much important for them…

GENERAL GUIDELINES FOR COMPOUNDING AND DISPENSING

- Wear a freshly laundered overall coat
- Dispensing bench, equipments and containers must be clean
- Read the prescription carefully make sure you understand it and that it is legally correct
- Ensure that the prescription has the name and signature of the prescriber and the stamp of the health centre
- Ensure that the prescription is dated and has the name of the patient
- Confirm that there are no pharmaceutical or therapeutic incompatibilities in the preparation
- If necessary find the formula of the preparation
- If you are not sure about correct method of preparation refer to your practical notebook
- Select and weight the correct ingredients

- Always return the ingredients back to their place
- Balance must be tarred before use, (Re-zeroing balance by hitting Tare button on it)
- Balance must be placed in a air free place
- Never weigh less than minimum or more than maximum weight declared on the balance.
- Collect the correct container and closure
- Look up the storage conditions for the preparation
- Write the main label and collect any special labels that are required
- Check the labels and fix them to the container
- Pack the preparation in a suitable container
- Check the finished preparation
- Pack the container in a suitable box and write the patients name and address
- Make the appropriate records in your register
- Record must be kept for a minimum of 2 years or according to the law

Weights and Measures

Weight

It is a measure of the gravitational force acting on a body and is directly proportional to its mass. Or

The weight of an object is usually taken to be the force on the object due to gravity

Measures

Finding out the size, amount, or degree of (something) by using an instrument or device marked in standard units is called measures. Or

A standard unit used to express the size, amount, or degree of something.

System of Measurement

A system of measurement is a set of units of measurement which can be used to specify anything which can be measured

There are two Systems of weights and measures

1. **The Iimperial System**
2. **The Metric System**

Imperial System

A system of weights and measures originally developed in England.

Example of Imperial measures

Length: inches, feet, yards
Area: square feet, acres
Weight: pounds, ounces,
Volume: fluid ounces, gallons

The Imperial System has been replaced by the Metric System in most countries (including England). We will discuss only metric system in detail

Metric System

The most commonly used system of weights and measures in pharmacy is the metric system. Understanding of the metric system is important to perform calculations in the pharmacy.

Values of Prefixes in the Metric System

The three basic units of the metric system are the meter, the gram, and the liter. The names of the other units are formed by adding a prefix to one of the basic units. Each prefix has a numerical value as indicated below:

Prefix Values

Micro - (mc) = 1/1,000,000
Milli - (m) = 1/1,000
Centi - (c) = 1/100 times the basic unit.
Deci - (d) = 1/10
Deka - (dk) = 10
Hecto - (h) = 100 times the basic unit.
Kilo - (k) = 1000

Standard Unit of Weight in the Metric System Used in the Pharmacy

Common measures of weight in metric system
(a) 1 kg = 1000 g
(b) 1 g = 1000 mg
(c) 1 mg = 1000 mcg

Whereas
Kg = kilogram
g = gram
mg = milligrams
mcg = microgram

The gram (g or gm) is the basic unit of weight used to weigh solids in the pharmacy.

1 kilogram (kg) = 1000 gm
1 hectogram (hg) = 100gm
1 decagram (dag) = 10gm
1 gram (gm) = 1000 milligrams (mg)
1 decigram (dg) = 0.1gm or 100mg
1 centigram (cg) = 0.01gm or 10mg
1 milligram (mg) = 0.001gm or 1mg

Standard Unit of Volume in the Metric System

1 kiloliter (kl) = 1000 liters

1 hectoliter (hl) = 100 liters

1 decaliter (dal) = 10 liters

1 liter (l) = 1,000 milliliters (ml)

1 milliliter = 1 ml

1 deciliter (dl) = 0.10 L or 100ml

1 centiliter (cl) = 0.01 L or 10ml

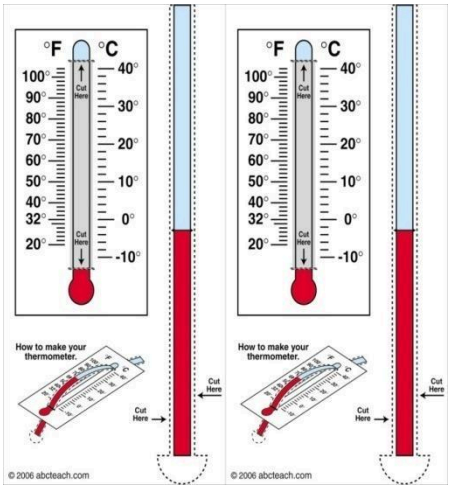
20 drops of water droplets makes about 1 milliliter

1 teaspoon of liquid Teaspoonful is about 5 milliliters

Measurement of Temperature

Centigrade or Celsius temperature scale

Celsius temperature scale also called centigrade temperature scale, is the scale based on 0 for the freezing point of water and 100 for the boiling point of water.



Fahrenheit temperature scale

Fahrenheit temperature scale is a scale based on 32 for the freezing point of water and 212 for the boiling point of water.

Conversions of Temperature

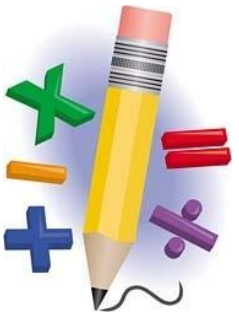
The following formula works for converting both ways; that is, conversions can be made from Fahrenheit to Centigrade or from Centigrade to Fahrenheit using this formula:

5F = 9C + 160

CALCULATION

DENSITY

Density is defined as the mass of a substance per unit volume. Or



Density is defined as mass divided by volume

Density = mass/volume

Or

Density = mass divided by volume

or

$$\rho = \frac{m}{V},$$

The unit of density is kg/m^3 (kg per cubic meter)

MASS

A measure of how much matter is in an object is called mass

Mass = density x volume

The unit of mass is kg (kilogram)

VOLUME

Volume is the measure of space occupied by an object.

Volume = weight /density

In metric system unit of volume is liter (L), on the other hand, one liter is the volume of a 10-centimetre cube, 1 liter = (10 cm)3

PERCENTAGE

Percent means "parts per hundred" and is expressed in the following manner. Or

Percentage is the rate, number, or amount in each hundred.

Percentage = number of parts/ 100 parts

Percentage Preparations

There are three types of percentage preparation

1. **Weight in volume (W/V)**
2. **Weight in weight (W/W)**
3. **Volume in volume (V/V)**

Weight in Volume (W/V)

W/V of Weight/Volume percent is defined as the number of grams in 100 milliliters of solution.

Example

(10% w/v solution of NaCl)

A 10 percent (w/v) sodium chloride (NaCl) solution would contain 10 grams of sodium chloride in every 100 milliliters of water.

Weight in Weight (W/W)

W/W percent or Weight/Weight percent is defined as the number of grams in 100 grams of a solid preparation.

Example

(5% w/w boric acid ointment)

A 5 percent (w/w) boric acid ointment would contain 5 grams of boric acid in each 100 grams of boric acid ointment.

Volume in Volume (V/V)

V/V percent or Volume/Volume percent is defined as the number of milliliters of a liquid in every 100 ml of solution.

Example

(70% v/v solution of alcohol)

A 70% (v/v) alcoholic solution would contain 70 milliliters of alcohol in every 100 ml of solution.

Packaging of Pharmaceuticals

Packaging is an art as well as science in preparing a product for transport, storage, display and use.

Suitable packaging is important for suitable purity, potency, and stability of a product.

Components Of Package

A package consist of

- **Container**
- **Closure**
- **Carton or outer**
- **Box**

Container

In which product is placed is called container.

Closure

Closure, which seals the container to exclude oxygen, carbon dioxide, moisture, bacterial etc. and to prevent the loss of water and volatile substances from product.

Carton Or Outer

Carton or outer are used for secondary protection against mechanical and environmental hazards and also serves for display of written information.

Box

Multiples of the products are packed in box. It also defense against external hazards.

Characteristics of Containers and Closures

- The container and closure must be sufficiently strong to withstand (remain undamaged or unaffected) handling while emptying, filling, closing, sterilizing, labeling, transporting, storing and use by the consumer.
- The container and closure should not allow any loss of product due to leakage.
- The container and closure must not react with the contents.
- The container and closure must be heat stable if process includes sterilization by heat.
- The surface of the container must be clear for easy labeling.
- The container and closure must not absorb substances from the preparation.
- The container and closure must not impart its own color, taste or odor to the preparation.

- The container and closure must not react either with each other or with the preparation.
- The container should be able to protect light sensitive preparations for which amber colored glass containers may be used.
- The size of the container must be selected according to the size of the preparation.
- The closure must be easy to remove and replace.
- The cost of container and closure should not be high.
- The container and closure should be attractive in appearance.

PRESCRIPTION

Prescription is an order written by a physician dentist or any other registered medical practitioner to a pharmacist to compound and dispense a specific medication for the patient. Or

A prescription is a set of instructions written by a qualified prescriber to a pharmacist for supply of drugs.

PARTS OF A PRESCRIPTION

A complete prescription should have the following parts:

- Date
- Name, age, sex and address of the patient
- Superscription
- Inscription
- Subscription
- Signatura
- Prescriber's Name, Address, registration number and signature

Date

Date must be written on the prescription by the prescriber at the same time when it is written.

Name, Age, Sex, and Address of the Patient

Name, age, sex, and address of the patient must be written on the prescription. If it is not written, then the pharmacist himself should ask the patient about these particulars and write down at the top of the prescription.

Superscription

The superscription is represented by a symbol Rx which is always written at the beginning of the prescription, (Rx = you take).

Inscription

This is the main part of the prescription. It contains the names and quantities of the prescribed medicine or ingredients. The names of the medicine or ingredients are written each on a separate line.

Subscription

This part of the prescription contains prescriber's directions to the pharmacist regarding the dosage form to be prepared and number of doses to be dispensed. It may also include instruction regarding the flavor of the product, label etc.

Signatura

It is usually abbreviated as (sig) on the prescriptions and consists of the directions to be given to the patient.

These may include

- The method of administration and application
- The dose if the preparation is for internal dose
- The time of administration or application
- The part of body where the preparation is to be applied, in case of external use

The Prescriber's Name, Address, Registration Number and Signature

The Address and registration number may be printed but the prescriber's name must be hand-written and should be signed with ink.

Prescriptions were written in Latin; partly because this is the language could be understood by pharmacist all over the world and to hide the nature of treatment from the patient partly. In recent years the use of Latin has rapidly declined.

ABBREVIATIONS COMMONLY USED IN PRESCRIPTIONS

Rx = take
sig = signature

tab = tablet
cap = capsule
inj = injection
syr = syrup
supp = suppository

od = once a day
bid = twice daily
tid/tds = thrice daily
qid (qds) = four times daily

im = intramuscular
iv - intravenous
sc = subcutaneous

wt = weight

mg = milligram

g = gram

kg = kilogram

mg/kg = milligram per kilogram

ml = millilitre

tbsp = tablespoonful (=10 ml)

tsp = teaspoonful (= 5 ml)

oz = ounce (1 oz is equal to approximately 28 grams)

lb = pound (1 lb is equal to approximately 453 grams)

HANDLING AND FILLING OF PRESCRIPTION

HOW TO HANDLE AND FILL A PRESCRIPTION

Being a pharmacy technician is a very important job. A pharmacy technician answers phone calls, takes prescriptions from patients, and dispenses it according to the instructions. The most important duty of a pharmacy technician is handling and filling prescriptions. Here are a few simple steps on how to handle a prescription in a pharmacy.

1. **Receiving and entering prescription into the register or computer**
2. **Reading and checking**
3. **Collecting the materials**
4. **Weighing**
5. **Compounding**
6. **Labeling**
7. **Final checking of preparation**
8. **Giving to the patient**

Step 1: Receiving and entering prescription into the register or computer

The prescription should be received from the patient by the pharmacist himself. After receiving the prescription, enter it into the register or computer system.

Step 2: Reading and checking

Carefully read and check the prescription for any type of incompatibility.

Step 3: Collecting the material

Collect the correct material according to the prescription.

Step 4: Weighing

Carefully weigh the ingredients.

Step 5: Compounding

Perform the compounding according to the instruction of the prescription

Step 6: Labeling

Once the drug is prepared place label around it.

Step 7: Final Checking of Preparation

Give the drug that has been prepared to the pharmacist to be checked for correctness.

Step 8: Giving to the patient

If the prescription is correct, then give it to the patient and ask the question if they have any.

LABELLING

A label is written, printed or graphic matter attached on a container to identify its contents and inform the consumer about its qualities, uses and hazards. Labels must be attached to the outside of the immediate container.

Label must include the following

- The name and address of the dispenser or pharmacy
- The serial number of the prescription
- The current date of its filling or refilling
- The name of the prescriber
- The name of the patient
- The directions for use, including precautions, if any, as indicated on the prescription
- The initials or name of the dispensing pharmacist
- The telephone number of the pharmacy
- The drug name and strength and quantity

(Some labels may have the above mentioned information in different order)

EXTEMPORANEOUS DISPENSING

The WHO defines extemporaneous dispensing or preparation as the technique used by pharmacists to produce medicines, within their pharmacy, from ingredients when no commercially available, authorized, age-appropriate dosage form exists. Or

Simply we can say extemporaneous dispensing is preparation of any dosage form at the time of dispensing. This is done when there is no appropriate commercially medicinal products are available for the treatment of a patient.

SOLUTIONS

According to the British Pharmacopoeia (BP)
Oral solutions are oral liquids containing one or more active ingredients dissolved in a suitable vehicle. Or

Solution is a homogeneous liquid preparation that contains one or more dissolved medicaments.
(A solute is a substance dissolved in another substance, known as a solvent.)

Solutions are used for many purposes. Sterility is necessary for some solutions, e.g. parenteral peritoneal dialysis and anticoagulant solutions. Unsterile solutions are used orally. Generally, water is chosen as the vehicle in which medicaments are dissolved, since it is non-toxic, non-irritant, tasteless, relatively cheap and many drugs are water soluble.

SUSPENSIONS

According to the British Pharmacopoeia (BP)

Oral suspensions are oral liquids containing one or more active ingredients suspended in a suitable vehicle. Or

A pharmaceutical suspension is a preparation in which at least one of the active ingredients is suspended throughout the vehicle. (In contrast to solutions, in a suspension at least one of the ingredients is not dissolved in the vehicle and so the preparation will require shaking before a dose is administered).

Suspensions are important pharmaceutical dosage forms that are still widely in use today.

Common pharmaceutical products that are suspensions include:

- Ear drops

- Inhalations
- Lotions
- Mixtures for oral use

Emulsion (Emulsion Cream)

Emulsion may be defined as a thermodynamically unstable system of at least two immiscible liquid phases, one of which is dispersed as globules in other liquid phase, stabilized by presence of emulsifying agent. Or

Emulsion is liquid dosage form of medicament, in which, two immiscible liquids are mixed with the help of emulsifying agent. (Emulsifying agent is called emulgent)

Creams

Creams are semi-solid emulsions usually for application to the skin. They may be medicated or non-medicated. Creams or emulsions are divided into two types

Oil-in-Water (O/W) creams which are composed of small droplets of oil dispersed in a continuous water phase.

Water-in-Oil (W/O) creams which are composed of small droplets of water dispersed in a continuous oily phase.

(Aqueous cream = in it, emulsion is oil in water)
(Oily cream = in it, emulsion is water in oil)

Ointments

Ointments are greasy-semisolid preparation for application to the skin. An ointment is a fatty preparation as to be easily applied to the skin. They may be medicated or non-medicated.

Medicated ointments contain the medicament either dissolved or dispersed in the vehicle, and non-medicated ointments are used as vehicles for preparation of medicated ointments or can be used for their physical effects e.g. softening the skin.

Pastes

Pastes are dispersion of high concentration of insoluble powdered substances (20-50%) in a fatty or aqueous base.

Pastes are semi-solid preparation for external application. Pastes are less greasy and stiffer than ointment due to high solid concentration.

GELS

Gels are semi-solid colloidal (jelly-like) suspension of a solid, dispersed in a liquid e.g. aluminum hydroxide gel used as an antacid. Or

Jelly like preparation containing cosmetic, medicinal or other agents.

SUPPOSITORIES

Suppositories are solid dosage form intended for insertion into body cavities such as rectum, vagina, where they soften, melt or dissolve in the cavity, fluid releasing active ingredient.
Suppositories melt at body temperature which releases the medicine and ultimately show localized and systemic effects.

PESSARIES

Pessaries are solid medicated preparations for introduction into the vagina where they melt or dissolve and exert a local action.

There are two types of Pessaries

1. **Molded Pessaries**, which are cone shaped and prepared in a similar way to suppositories.
2. **Compressed Pessaries**, which are made in varieties of shape, like tablet, and prepared by compression.

POWDERS

Powders are homogenous solid dosage form of medicament for internal or external use. These are fine and dry particles of one or more substances produced by grinding or crushing of a solid substance.

GRANULES

Granules are solid dosage form used for my purposes. Granules are prepared from powdered substances. The particles of powder are aggregated (combine) by additions of solvents or binding agents.

Granules are generally irregular shaped and behave as single large particles. Granules are used in the manufacturing of tablets and pellets. Granules typically have a size range from 0.2-4.0mm.

(Granulation is the act or process in which primary powder particles are made to adhere (stick) to form large).

Introduction to Aseptic Dispensing and TPN Dispensing

Aseptic dispensing is the preparation and supply of sterile medical products, which require some dilution or other handling before administration. The preparation is carried out in the pharmacy by trained pharmacy technicians, assistants and pharmacists.

The preparations are aseptically dispensed in response to a prescription/ order for a patient, under the supervision of a pharmacist.

Sterilization

Sterilization is a process that eliminates (removes) or kills all forms of microbial life such as fungi, bacteria, viruses, spore forms, etc.

Basic Approaches for Sterile Preparation

1. **Terminal Sterilization**
2. **Aseptic Process**

(Aseptic: the complete absence of living microorganisms)

Terminal Sterilization

Terminal sterilization is a more traditional method of sterilizing products. In terminal sterilization, we fill a container, seal it and then sterilize it.

Whenever possible, products intended to be sterile should preferably be terminally sterilized by heat in their final container.

Aseptic Process

Aseptic processing is the process by which a sterile product is packaged in a sterile container in a way that maintains sterility. Aseptic processing is a simple idea. Sterilize a container, sterilize its cap, sterilize its contents and put them together.

Where it is not possible to carry out terminal sterilization by heating due to the instability of a formulation, a decision should be taken to use filtration and/or aseptic processing.

In order to maintain the sterility of the components and the product during aseptic processing, careful attention needs to be given to the environment, personnel, container & closure sterilization and transfer procedures.

TOTAL PARENTERAL NUTRITION (TPN) DISPENSING

All people need food to live. Sometimes a person cannot eat any or enough food because of an illness. The stomach or bowel may not be working normally. When this occurs, and you are unable to eat, nutrition must be supplied in a different way. One method is “parenteral nutrition” (intravenous nutrition).

The person receiving parenteral nutrition that contains glucose, amino acids, lipids and added vitamins and minerals etc then it is called total parenteral nutrition (TPN). Solutions for total parenteral nutrition may be customized to individual patient requirements, or standardized solutions may be used.

Before dispensing TPN, look at the solution closely. It should be clear and free of floating material. Gently press the bag or observe the solution container to make sure there are no leaks. Do not use the solution if it is discolored, contains particles or it is leaks. Before using TPN place it in a clean, dry area to allow it to warm to room temperature.

PHARMACEUTICAL INCOMPATIBILITY

A pharmaceutical incompatibility may be defined as the result of prescribing or mixing the substances which are antagonistic in nature and an undesirable product is formed which may harmful for health.

TYPES OF INCOMPATIBILITY

There are three types of incompatibility

1. **Therapeutical incompatibility**
2. **Chemical incompatibility**
3. **Physical incapability**

THERAPEUTICAL INCOMPATIBILITY

This incompatibility is resulted due to the combination of drugs having antagonistic or opposing properties.

Types of therapeutic incompatibilities

1. **Overdose**
2. **Wrong dosage form**
3. **Contraindication**
4. **Drug synergy**
5. **Drug antagonism**

OVERDOSE

Too large or too many doses are called overdose.

WRONG DOSAGE FORM

The administration of a medication in a dosage form different from the one that was ordered by the prescriber is called wrong dosage form.

CONTRAINDICATION

A reason that makes it inadvisable to prescribe a particular drug or employ a particular procedure or treatment.

Drug synergy

Drugs that taken together produce a greater effect than the sum of their individual effects.

DRUG ANTAGONISM

An interaction between two or more drugs in which one drug blocks or reverses the effect of another drug.

EXAMPLES OF THERAPEUTICAL INCOMPATIBILITY

Rx

Codeine phosphate 0.6 gm

Type: Therapeutic incompatibility

In the present prescription an overdose of codeine phosphate has been prescribed. Therefore the prescription must be referred back to the prescriber.

Rx

Tetracycline hydrochloride 250 mg

Label: take one capsule every six hours with milk

Type: therapeutic incompatibility

In this prescription the direction is wrong. Tetracycline is inactivated by calcium which is present in milk. Therefore tetracycline capsules should not be taken with milk. Therefore the prescription must be referred back to the prescriber.

CHEMICAL INCOMPATIBILITY

Chemical incompatibilities are those in which a chemical reaction takes place between the ingredients and a new undesirable compound is formed.

Types of Chemical Incompatibility

Tolerated

In this type of incompatibility, chemical reaction can be reduced by mixing the solution in dilute forms or by changing the order of mixing.

Adjusted

In this type of incompatibility, change in the formulation is needed with a compound of equal therapeutic value e.g. in the mixture of caffeine citrate and sodium salicylate, caffeine citrate is replaced with caffeine.

Example of Chemical Incompatibility

Rx

Quinine Sulfate 2 g
Dilute Sulfuric Acid 2ml
Sodium acetate 4g
Water 120ml
Make suspension
Type: Chemical incompatibility

If the quinine sulfate is dissolved by the use of sulfuric acid and mixed with the solution of sodium acetate, a bulky white precipitate of quinine acetate will be formed. However, if the acid is omitted a fine suspension of quinine sulfate is produced.

Physical Incompatibility

Physical incompatibilities are those when two or more than two substances are combined together a physical change takes place and an unacceptable product is formed since these changes which take place are usually visible therefore they can be easily corrected by applying the pharmaceutical skill to obtain an acceptable preparation.

Types of physical incompatibility

Immiscibility, insolubility, precipitate formation and liquefaction of solid materials are common types of physical incompatibility

EXAMPLE OF PHYSICAL INCOMPATIBILITIES

Rx

Olive oil water

Water 15ml

Olive oil 60ml

Make an emulsion

Type: physical incompatibility

In this prescription olive oil is immiscible with water. To make them miscible an emulsifying agent must be used.

Course Outlines

PHARMACEUTICS-1 (General, Physical and Dispensing) (WRITTEN)

Paper 4	Part-1	100 (50+50) Marks

1. Introduction of pharmacy in relation of Hospital Pharmacy, Clinical Pharmacy, Retail pharmacy, industrial pharmacy and Forensic pharmacy.
2. History of pharmacy with special reference to contribution of Muslim scientists in pharmacy
3. An introduction of various official books used in pharmacy.
4. Surface tension, Viscosity, Ionization, pH, pH indicators, buffers, isotonic solutions and their application in pharmacy.
5. Introduction and application to the following processes in Pharmacy adsorption, calcinations, centrifugation, crystallization, Decantation, Deliquescence, Desiccation, Distillation, Efflorescence, Elutriation, Evaporation, Exsiccations, Fusion, Ignitions, Levigation, Lyophilizaition, Sublimation, Trituration, vaporization.
6. Introduction to various Dosage forms.
7. Basic Principles of compounding and dispensing including, Weights and measures, calculation for compounding and dispending containers and closures. Prescription handling Filling interpretation, labeling.
8. Extemporaneous, Dispensing of solutions, suspensions, emulsions creams and ointments, pastes and gels, suppositories and passaries, powder and granules, oral unit dosage form.
9. Introduction to aseptic dispensing and TPN Dispensing
10. Introduction to incompatibility.