**DDR COLLEGE OF PHARMACY PHARMACEUTICAL CHEMISTRY – I D. Pharmacy First Year**

**Question No. 01.** What are Antacids? Describe combination of antacid preparation with examples and explain Aluminium hydroxide.

**Question No. 02. (a)** What are acids and bases? Discuss about the various concepts about acids and bases.

**(b)** What are the radiopaques? Explain with example.

**(c)** What are official preparations of iodine? Describe povidone iodine, ammoniated mercury & chlorinated lime.

**Question No. 03.** Define Radiopharmaceuticals. What are biological effects of radiations and storage conditions of radiopharmaceuticals? Discuss methods of quality control of active pharmaceutical ingredient as per pharmacopoeia.

**Question No. 04.** Describe in detail the principle and procedure involved in limit test for Arsenic and Sulphate.

**Question No. 05.** Describe in detail the sources of impurities in pharmaceutical chemicals. Give importance of quality control of the drugs.

**Question No. 06.** Define electrolyte replacement therapy. What are the role of major intra and extra cellular electrolytes? Explain the preparation, properties and uses of sodium chloride.

**Question No. 07.** Give physical and chemical properties and uses of each compound.

(a) Borax (b) Alum (c) Boric Acid (d) Zinc sulphate (e) Zinc chloride

**Question No. 08.** What are Antidotes? Explain their mechanism & discuss cyanide poisoning in detail?

**Question No. 09.** (a) Define anions and cations. Describe identification test for $Na^{+}$, $K^{+}$, $Ca^{++}$, $Cl^{--}$, $SO_4^{--}$ and $HCO_3^{-}$.

(b) Describe limit test for Iron.

**Question No. 10.** Write short note on the following:

(a) Antimicrobials (b) Astringents (c) Protective and adsorbent (d) Antioxidants (e) Expectorant and Emetics

**Question No. 11.** (a) Discuss in brief the dental products.

(b) Define the buffer solution? How many types of buffer solution are there? Explain.

**Question No. 12.** Write down: (a) Chemical formula and use of laughing gas (b) Pharmaceutical uses of nitrogen (c) Composition of soda lime (d) Buffer capacity (e) Temperature range for storage of drugs under cold condition and cool condition (f) Differentiate very soluble and freely soluble salts**.**

**Question No.13.** Write storage conditions of following compounds; iodine, normal saline solution, chlorinated lime, sodium hydroxide. Also explain the reason

**Question No. 14.** Write a note on physiological acid base balance.

**Question No. 15.** (a) Write down the theory of limit test for chloride.

(b) Name four official compounds of calcium and explain the physiological role of calcium in human body.

**Question no. 16**. What is the principle of Geiger muller counter?



**ANSWERS:**

**Question No. 01. What are Antacids? Describe combination of antacid preparation with examples and explain aluminium hydroxide.**

**Ans. Antacids:** Antacids are substances which on ingestion react with the gastric acid and lower the acidity of gastric contents. They produce a symptomatic relief of heartburn, pain and also reduce spasm in addition to relief from the uncomfortable feeling from overeating and growing hungry feeling between meals. Antacids are weak bases and they raise the gastric pH above 4 by neutralizing excess gastric hydrochloric acid, which may be causing pain and possible ulceration. One may also use antacids to inactivate proteolytic enzyme, pepsin.

**Ideal characteristics of antacids:** As no antacid is ideal but preferably an antacid should have following properties:-

i) It should not be absorbable or cause systemic alkalosis.
ii) It should not interfere with absorption of food.
iii) Antacid should not be a laxative or cause constipation.
iv) Antacid should have buffer nature in the pH 4-6 range.
v) They should probably inhibit pepsin.

**Examples are**: - (a) Sodium bicarbonate $NaHCO_3$ (b) Aluminium hydroxide $Al(OH)_3$ (c) Calcium carbonate $CaCo_3$ (d) Magnesium carbonate

**Antacids can be classified into two types:**

**1. Absorbable or systemic antacids:** Which are soluble, readily absorbable and capable of producing systemic electrolytic alterations and alkalosis e.g. sodium bicarbonate.

**2. Non-absorbable or non-systemic antacids:** Which are not absorbed to a significant extent and thus do not exert an appreciable systemic effect e.g. Calcium carbonate, Aluminium phosphate and Aluminium hydroxide.

**Combination of antacid preparation:-** As no single antacid meets all the requirements for an ideal antacid, so combination of antacid are used to balance constipation effect of calcium with laxative effect of aluminium compounds. So these products contain a fast acting antacid, which one supposedly having longer duration of action.

**Some commonly used combinations are:-**

i) Aluminium hydroxide gel - Magnesium hydroxide combination

ii) Aluminium hydroxide gel - Magnesium trisilicate combination

iii) Calcium carbonate - Hydroxide gel & magnesium containing antacid combination

iv) Alginic acid containing antacid combination

**Aluminium hydroxide:**

**Chemical formula:** $Al(OH)_3$

It occurs in two forms:

1. Aluminium hydroxide gel

2. Dried Aluminium hydroxide gel

**Properties:** It is a white, light, odourless, tasteless amorphous powder. It is practically insoluble in water and alcohol, soluble in dilute mineral acids and in solutions of alkali hydroxides. It is amphoteric in nature and is slightly affects both red and blue litmus papers.

**Uses:**

1. It is used as mild astringent and desicant.

2. It is used in the treatment of diarrhoea & cholera.

**Question No. 02. What are acids and bases? Discuss about the various concepts about acids and bases.**

**Ans. 2 Acids & Bases:** Acids and bases are the substances or liquid which play an important role in pharmaceutical chemistry. These are required not only in the manufacture & quality assurance of drug, but are also required as pharmaceutical aid & necessities in dispensing pharmaceutical for their stability, compatibility & optimum distribution in various physiological system. At present there are several concepts or theories of acids & bases. All of them are variations of the well known classical *Arrhenius theory of ionization* concept. One interpretation may be better suited than other, depending upon the particular acid base reaction or the system involved.

**Theories of acids and bases:** The various theories of acids and bases are as follows:

1) **Arrhenius concept:** It was the first concept given by scientist Arrhenius. According to him acid is the substance which yield $H^+$ ion [hydrogen ion] in water and conversely bases are substances, which releases hydroxyl ion [OH] in water. For example:

$$HCl \xrightarrow[\text{Aqueous Media}]{} H^+ + Cl^- \quad \text{[Strong acid]}$$

$$NaOH \xrightarrow[\text{Hydroxyl ion}]{} Na^+ + OH^- \quad \text{[A base]}$$

**Disadvantage:**

i) It does not explain the basic nature of ammonia [$NH_3$], however it does not liberate hydroxyl ion.

ii) It does not explain the acidic nature of $CO_2$; however it does not liberate hydrogen ion [$H^+$].

iii) It explains the acidic and basic nature only in presence of water.

**2. Bronsted-Lowry concept:** According to this concept an acid is a substance that can donate a proton. So it is called proton donor. Whereas base is a substance which can accept a proton i.e., it is called proton acceptor.

For example: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$

Acid Base

**3. Lewis concept:** According to this concept, base is a substance, which is electron pair donor and acid is a substance, which is electron pair acceptor. Lewis base is also called **nucleophillic** and Lewis acid is also called **Electrophillic.** For example**:** Lewis bases are Ammonia, Amine and Ether.

**Advantage:**

i) This concept also includes those reactions in which no protons are involved.

ii) It explains the long accepted basic properties of metallic oxides and acidic properties of non-metallic oxides.

**4. Usanovich concept:** According to this concept acid is a chemical species, which is capable of combining with anions or electrons or giving up cations. Conversely, a base is a chemical species, which is capable of giving up anion or electrons or combining with cation.

$SO_3$ + $Na_2O$ → $Na_2SO_4$
Acid Base Salt

$Fe(CN)_2$ + 4 KCN → $K_4[Fe(CN)_6]$
Acid Base Salt

**Advantage:** It explains all the acids and bases.

**Question 3: What are the radiopaques? Explain with example.**

**Ans. 3 Radio–Opaque contrast media (radiopaques)**: The X-ray contrast media are the chemical compounds which have the ability to absorb X-rays and block the passage of X-rays. Thus they are opaque to X- ray examination. X-rays are capable of passing through most soft tissues. When a photographic film or a photosensitive plate is placed opposite to the X-ray source through patient's body/organ portions, the film or plate is darkened in an amount proportional to the number of X-rays that are able to pass. Bony structures, cartilage and teeth are capable of blocking the passage of X-rays and appear light on exposed X-ray film. But skin and soft structures, being less dense and they appears only as shadows on X-ray film. So to make a correct diagnosis of soft organ, radiopaques substances are used. Radiopaques substances have no pharmacodynamic effect in the body. The most common example of contrast media is barium sulphate.

**Barium sulphate:**

**Synonym:** Barium meal

**Chemical formula:** $BaSO_4$

**Preparation:** It is prepared from a solution of Barium chloride with cold dilute $H_2SO_4$ or soluble sodium sulphate. $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2\,HCl$

$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2$ NaCl The Barium sulphate precipitated, washed and dried.

**Properties:** It is a fine, white powder free from gritty particles, odorless and tasteless and insoluble in water and organic solvent. It dissolves in concentrated $H_2SO_4$ with the formation of bisulphate salt.

$BaSO_4 + H_2SO_4 \longrightarrow Ba[HSO_4]_2$

**Storage:** Store in well-closed containers.

**Uses**:

i) Barium is given only by its salt i.e. Barium sulphate. Its salt is given to identify location of ulcers in G.I.T. wherever ulcer is formed.
ii) It is also used on respiratory muscles and muscles of cardiovascular system but cause toxicity.
iii) In G.I.T. mucosa, cells absorb $BaSO_4$ and ulcer spot is identified with the help of X-Ray film.

**Question 4: What are official preparations of iodine? Describe povidone iodine, ammoniated mercury & chlorinated lime.**

**Ans. 4 Preparation of Iodine:** Iodine is used an antimicrobial agent acts by formation of hypoiodous acid (HIO) which is six times more effective than hypochlorous acid it is used for disinfecting unbroken skin. Iodine deficiency causes goiter for this purpose iodized salts with sodium iodides.

**There are various types of iodine solution:-**

1. Aqueous iodine solution B.P. /I.P. (1966).
2. Weak Iodine solution B.P. /I.P. (1966).
3. Strong iodine solution I.P. (1966).
4. Iodine tincture U.S.P.
5. Iodine Povidone ointment.

**(i) Povidone iodine:** It is a complex of iodine with a polymer povidone [poly (2-oxo, pyrrolidin-1-ethylene)].

**Physical properties:** It is yellowish brown, amorphous powder, characteristic iodine odour, soluble in water and 95% ethanol but practically insoluble in chloroform and acetone.

**Storage:** It should be stored in airtight containers.

**Uses:**

1. It is used as antiseptics for surgical scrubs and pre- operative antisepsis of the skin.

2. It is also used in gargles and mouthwashes for the treatment of infections in the oral cavity.

3. The solution of povidon iodine is also use for vaginal candidacides.

**(ii) Ammoniated Mercury:**

**Synonyms:** White precipitate, aminochloride of mercury

**Chemical formula:** $NH_2HgCl$

**Preparations:** It is prepared by treatment of 5% mercuric chloride solution with 20% dilute ammonia solution. The precipitate is collected, washed with cold water and dried below $30^{o}$ C.

$$HgCl_2 + 2NH_3 \longrightarrow NH_2HgCl + NH_4Cl$$

(Precipitates)

**Physical properties:** It is white powder, odorless, practically insoluble in water, alcohol and ether.

**Storage**: It should be protected from light & stored in well closed containers.

**Uses:** It is used as anti-infective. It is used externally in the form of ointments to destroy threadworm and in staphylococcal infections of skin and in psoriasis.

**Disadvantage:** Excess uses of ammoniated mercury develop chronic toxicities therefore prolonged use is not recommended.

**(iii) Chlorinated lime:**

**Synonyms:** Bleaching powder, Chlorinated lime, Chloride of lime

**Chemical formula:** Ca (OCl)Cl

**Preparation:** It is prepared by passing chlorine gas over dry calcium hydroxide in a lead chamber for 18-24 hours. $Ca(OH)_2 + Cl_2 \longrightarrow Ca(OCl)Cl + H_2O$

**Physical properties:** It is a dry, dull white powder with characteristic odour. It is slightly soluble in water and in alcohol.

**Storage:** It should be stored in well closed container. It slowly decomposes with loss of chlorine.

**Uses:**

1) Used as bleaching agent.

2) Used in preparations of detergents.

3) Used as disinfectant in wounds and swimming pools.

**Question No. 05. Define radiopharmaceuticals. What are biological effects of radiations and storage conditions of radiopharmaceuticals? Discuss method of quality control of active pharmaceutical ingredient as per pharmacopoeia.**

**Ans. Radiopharmaceuticals:** The compounds or substances which emit radiations (alpha, beta, and gamma) continuously and which are used in medicines are called as radiopharmaceuticals.

**Biological effects of radiations:** Effect of radiations on biological tissues is known as biological effect of radiations. Radiations have dangerous effects on biological tissues depending on ability of radiations to penetrate the tissue, energy of radiation, surface area exposed etc. The radiations promote a number of irreversible changes in living cells. These are:

1. The chemicals, changes either the pH or initiate free radical chain reactions and forms peroxides and other toxic substances.
2. These can create necrosis and ultimately complete destruction of cell, tissue or organ.
3. The toxic substances produced from reactions of free radicals after DNA in cells and cause cross linking between amino acids and proteins. This leads to various defects in body. The reaction of free radicals occurs in following steps:-

**(I) Chain Initiation**

$$H_2O \xrightarrow[\text{Particles}]{\text{Radiation}} H. + HO.$$

**(II) Chain propagation**

$$H_2O + H. \rightarrow H_2 + .OH$$

$$H_2O + OH. \rightarrow H_2O_2 + H.$$

**(III) Chain termination**

$$H. + H. \rightarrow H_2$$

$$OH. + OH. \rightarrow H_2O_2$$

$$H. + OH. \rightarrow H_2O$$

**Handling and storage:** A care should be taken to protect people and personnel from harmful radiations during handling and storage of radioactive material. The following precautions are taken as:

1. These materials should be handled with forceps or suitable instruments and direct contact should be avoided.
2. Any substance that is taken internally [food, drinks], should not be carried in laboratory.
3. Sufficient shielding must be provided on protective cloths.
4. Sufficient protective clothing must be used while handling the materials.
5. Disposal of radioactive materials should be done with great care.

**Methods used for quality control:** The pharmacopoeial monograph of each compound/product is the a guiding document. A substance is required to confirm with the following parameters:

1. **Description**: Statements of those superficial qualities that can be determined without formal scientific examination e.g. colour, crystalline form, odour, taste etc.

2. **Identification:** It includes various specific and non-specific tests; physical constants and spectrophotometric matching.

**3. Method of assay:** - The term assay is used in the pharmacopoeias for the quantitative deterioration of principal ingredients of the official substance and their preparations. This is quantitative determination of principal ingredients by gravimetric or volumetric or instrumental or biological method, etc.

**4. Tests for purity: -** I.P prescribes tests for purity of almost all the official substances. These tests include melting point, boiling point, weight per ml., limit tests for chlorides, sulphates, iron, heavy metals, lead and arsenic, specific optical rotation, sulphated ash, loss drying, pH of solution etc. as may be applicable for the substance. There are over 130 different categories of tests mentioned in the pharmacopoeia in respect of inorganic pharmaceutical substances. Certain tests which are performed on the substances are:

**a) Colour, odour and taste-** Though these have limited values, still they are useful in determining whether the substance is reasonably pure, hygienic etc. or not, especially when other tests for purity are not available.

**b) Physico-chemical constants** - Physico-chemical constants are important criteria of purity of many pharmaceutical substances. Certain materials of indefinite or variable composition do not respond well to chemical analysis and for these physical methods are of prime importance. The pharmacopoeia attaches due importance to solubilities, determination of melting point, distillation range/boiling point, weight per ml/ density/ specific gravity, viscosity and other physical measurements. Chromatographic constants e.g. Rf values and retention time also serve as a good constant.

**c) Acidity, alkalinity and pH** - On account of incomplete purification of substances by inappropriate and insufficient washings after their separation in acidic or alkaline media, some degree of acidity or alkalinity may still remain in the final product. Further, solutions of certain substances have a definite pH at a specified concentration. A deviation of pH from a normal value in a given substance at the specified concentration will be indicative of the presence of incorporated impurities.

**d) Anions and cations**- On account of co-precipitation/post precipitation or adsorption certain anions and/or cations often get included in the final product. Chloride, sulphate, iron, lead, arsenic and heavy metals are few most common impurities and the pharmacopeia prescribes general quantitative or limit tests of tolerance of the impurities. For other anions or cations special tests of a quantitative nature are prescribed.

**e) Moisture determination**- Of some substances especially crude drugs provide valuable information about purity of specified substances.

**f) Insoluble residue**- Pure substances generally give a clear solution in a proper solvent at a specified concentration. Insoluble ingredients or impurities may make the solution cloudy, turbid or opaque or even insoluble suspension. The measurement of turbidity or opalescence or weighing the filtered the insoluble residue can serve as determination of the insoluble residue.

**g) Loss on drying/ignition-** On specified heating loss in weight upon drying or ignition also serves as an useful index towards purity determination.

**h) Ash, sulphate, ash, water insoluble ash-** Determination of ash in crude vegetable drugs, organic compounds and certain inorganic substances serves as a good indicator about the presence of heavy metals or minerals.

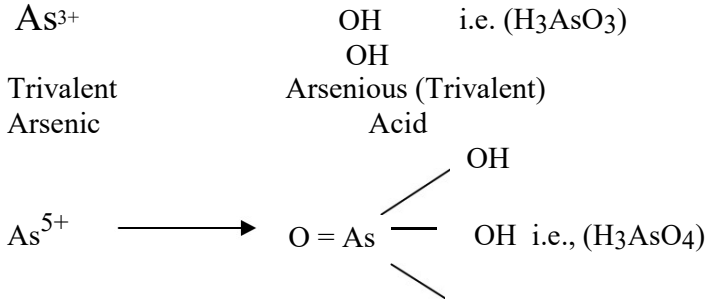
**i) Organic impurities and carbonisable substances-** These are determined in the specified substances as required in the monograph of the pharmacopoeia to ensure desired purity.

**j) Other physic-chemical parameters-** Such as swelling powder (e.g. bentonite, kaolin), bulkiness (barium sulphate), sedimentation volume (bentonite), soluble matter (kaolin) and stability of solution etc. also serves as parameters toward ensuring properties.

**Question No. 06. Describe in detail the principle and procedure involved in limit test for arsenic and sulphate.**

**Ans. Limit test for Arsenic:** Arsenic produces toxicity in the body therefore presence of arsenic, as impurity in the drug is not desirable. Indian Pharmacopoeia prescribes the limit for presence of arsenic as an impurity in various drugs.

**Principle:** 1. The sample is dissolved in acid, which converts the arsenic impurity into arsenious acid or arsenic acid depending upon the valency state of arsenic present in the sample.



Pentavalant Arsenic — Arsenic (Pentavalant) Acid

2. The solution is then treated with reducing agents to convert the pentavalant arsenic acid into trivalent arsenious acid.

$O = As(OH)(OH)(OH)$ (Arsenic acid) $\longrightarrow$ $As(OH)(OH)(OH)$ i.e., $(H_3AsO_3)$ (Arsenious acid)

3. Arsenious acid is then allow to reacts with nascent hydrogen [which is produced by Zn + HCl] and converted into gaseous arsenious hydride (arsenious gas).

$$H_3AsO_3 + 3H_2 \longrightarrow AsH_3 + 3H_2O$$

(Arsenious acid) (Arsine Gas)

4. Arsine gas is carried through the tube by the stream of hydrogen and out through the mercuric chloride paper. A reaction occurs between arsine and mercuric chloride which may be represented as follows.

$$2AsH_3 + HgCl_2 \longrightarrow Hg(AsH_2)_2 + 2HCl$$

Yellow stain

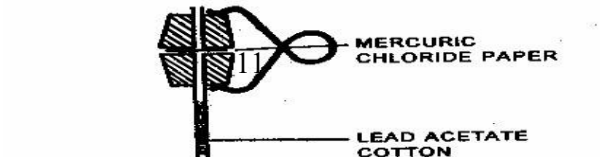
This results in the formation of a yellow or brown stain on the mercuric chloride paper.

The intensity of standard and sample stain is compared. The intensity of test solution should not be more than standard solution.

**Procedure of limit test**

| Steps | Test Solution | Standard Solution |
|---|---|---|
| 01. | Place 50 ml of distilled water in the bottle of an Arsenic test apparatus (as shown in the figure) label as test preparation. | Place 50 ml of distilled water in the bottle of another arsenic test apparatus and label it as standard preparation |
| 02. | Add 2.5 gm of ammonium chloride in the bottle and dissolve it. | Add 1 ml of arsenic standard solution in the bottle (10ppm arsenic) and mix. |
| 03. | Add 10 ml of stannated hydrochloric acid. | Add 10 ml of stannated hydrochloric acid. |
| 04. | Add 5 ml of 1M Potassium iodide solution. | Add 5 ml of 1 M Potassium iodide solution. |
| 05. | Add 10 gm of granulated zinc and fix all the fittings of the apparatus as shown in the figure and allow standing for 40 minutes in dark. | Add 10 gm of granulated zinc and fix all the fittings of the apparatus as shown in the figure and allow standing for 40 minutes in dark. |

Given substance passes the limit test if compare the yellow stain of test and standard preparation in daylight as soon as possible after the test is completed. If the stain produced in the test is of low intensity then standard preparation the test is passed.



**Limit test for Sulphates:-**

**Principle:** Limit test for sulphates depends upon the interaction of sulphates with barium chloride in the presence of hydrochloric acid. This results in the precipitation sulphates as barium sulphates. Hydrochloric acid is added to prevent precipitation of other acid radicals by common ion effect with barium chloride solution so that less barium ions are formed and precipitation of other acid radicals such as phosphate and oxalate is prevented. However in the presence of hydrochloric acid, only sulphates are precipitated.

**Procedure of limit test:**

| Steps | Test Solution | Standard Solution |
|---|---|---|
| 1. | Dissolve specified quantity of substances as given in monograph or prepare a solution as directed in individual monograph. In Nessler's cylinder labeled as **"Test".** Make up volume up to 10 ml. | Place 1 ml. of 0.1089 w/v solution of potassium sulphate in Nessler cylinder labeled as **"Standard"** Add about 9 ml, of distilled water. |
| 02. | Add 2 ml, of dilute hydrochloric acid. | Add 2 ml, of dilute hydrochloric acid. |
| 03. | Dilute to 45 ml, with distilled water. | Dilute to 45 ml, with distilled water. |
| 04. | Add 5ml of $BaSO_4$ reagent. | Add 5ml of $BaSO_4$ reagent. |

Stir the test and standard solution and allow standing for 5 minutes. Compare the turbidity against the dark background, if turbidity produce in standard is more than that in test, the sample compile limit test of sulphate as per I.P. 1985. Reaction will be as given below:

$$BaCl_2 + \text{sulphates} \longrightarrow BaSO_4 + \text{Chlorides}$$

**Question No. 07. Describe in detail the sources of impurities in pharmaceutical chemicals. Give importance of quality control of the drugs.**

**Ans. Sources of impurities**: Chemical purity means freedom from foreign matters in any pharmaceutical preparation. Pharmacopoeias fix limits of tolerance for certain impurities such as arsenic, lead, heavy metals, and iron etc.

**The various sources of impurities are as follow:**

**(a) Raw material:** If impurities are present in raw material, which is used in preparation of pharmaceutical chemicals then these impurities can be carried out during manufacturing process to final product. For example copper sulphate is prepared by action of sulphuric acid on copper turnings.

$$Cu + 2\ H_2SO_4 \longrightarrow CuSO_4 + 2\ H_2O + SO_2$$

Copper turning do contain iron and arsenic as impurities. These may be present in negligible amount or in more amounts; it will go to final product. That is harmful. So, Indian Pharmacopoeia (I.P.) prescribes the limit for these impurities and they should be not more than as prescribed limit.

**(b) Reagents used in manufacturing process:** The Reagents that are used in manufacturing process are not completely removed by washing. These may still present in final product. For example precipitated calcium carbonate prepared by inter-reaction of solution of calcium chloride and sodium carbonate

$$CaCl_2 + Na_2\ CO_3 \longrightarrow CaCO_3 + 2\ NaCl$$

(Soluble) (Soluble) (Precipitates) (Soluble)

The precipitates of calcium carbonate have to be washed thoroughly to remove excess sodium carbonate and the soluble chlorides. If precipitates are not washed properly they may be present in the final product as impurity. So Pharmacopoeia prescribes limits of tolerance for the soluble alkali.

**(c) Intermediate products in manufacturing process:** Sometimes an intermediate substance is produced during the manufacturing process may be carried through out to the final product. For example: –

$$6\ KOH + 3I_2 \longrightarrow 5\ KI + KIO_3 + 3H_2O$$

Potassium iodide is prepared by the interaction of potassium hydroxide and iodine. The resulting solution is evaporated to dryness and the residue is heated with charcoal.

$$KIO_3 + 3C \longrightarrow KI + 3CO$$

In this potassium iodate is an intermediate product and if it is not completely converted to potassium iodide, then it may be present as impurity in the final product.

**(d) Defects in manufacturing process:** Defects such as imperfect mixing, incompleteness of reaction, non-maintenance of absolute temperature, pressure, pH or reaction conditions etc may results in the formation of chemical compounds with impurities.

**(e) Solvents:** Water is the cheapest solvent and commonly used in manufacturing of pharmaceutical preparations but sometimes if purification is not done then these impurities of calcium, potassium, magnesium present in it and leads to impure product.

**(f) Action of solvent and reagent on reaction vessels:** Some solvents and reagents may react with metals of reaction vessel during manufacturing process and may dissolve these metals which appear as impurities in

final product. For example – Iron contains some amount of arsenic, when a preparation is made in iron vessel, some arsenic and iron released out in preparation and impurity take place. Because of that I.P prescribes the limit test for iron and arsenic.

**(g) Atmospheric contamination during the manufacturing process:** Atmospheric condition around the manufacturing process especially in the industrial area may contain dust particles, some gases such as sulphur dioxide, hydrogen sulphide etc. and black smoke. These impurities may enter in the preparations during the manufacturing process and may result as impurity in the final product. Further, some substances may contaminate with atmospheric air, or carbon dioxide and water vapors during their preparation, for example, sodium hydroxide readily absorb carbon dioxide from the atmosphere and results in the formation of sodium carbonate as impurity. Therefore sodium hydroxide should not be exposed to atmosphere during its manufacturing.

**(h) Adulteration:** Some of the pharmaceutical substances, which are expensive, may be adulterated with the cheaper chemical deliberately, for example, potassium bromide is adulterated with sodium bromide, as former is expensive than the later.

**(i) Defective storage of final products:** Some pharmaceutical undergo decomposition (Physical/ Chemical/ Biological) if the final product is not preserved under the prescribed conditions. For example, Iodine reacts with the cork, rubber and with some metals and these substances may be extracted in the final product as impurities; therefore iodine shall be preserved in the glass container with glass stopper.

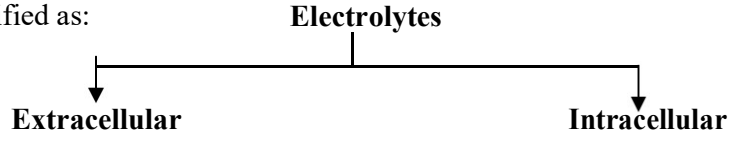
**Importance of quality control:** Quality control is vital in case of drugs and pharmaceuticals. There cannot be any compromise in this regard and one cannot even think of any second quality in drugs and pharmaceuticals. Standard for drugs and methods of quality control are monographed in pharmacopoeia which are official publications made in various countries. For example in our country "Indian Pharmacopoeia" is official and substances which are prepared and purified keeping in view the requirements of Indian pharmacopoeia and these when tested or analyzed, must confirm to the standards of quality prescribed for them.



**Question No. 08. Define electrolyte replacement therapy. What are the role of major intra and extra cellular electrolytes? Explain the preparation, properties and uses of sodium chloride.**

**Ans. Electrolytes:** These are those substances which are used to improve or correct the imbalance of intracellular and extra cellular ions in body for normal metabolism

Electrolytes are classified as:



→ Sodium ions
→ Chloride ions
→ Phosphate
→ Potassium
→ Magnesium

**Role of extracellular electrolytes**:

**Sodium ion ($Na^+$):** It maintain normal hydration and osmotic pressure, buffer constituent, acid- base balance, cell membrane permeability, muscle contraction, carbon dioxide transport, transmission of nerve impulses in nerve fibers. It is completely and readily absorbed, excreted in sweat and urine. Low serum $Na^+$ may occur with extreme loss of urine in diabetes leads to condition *hyponatremia.* High serum $Na^+$ level may occur in Cushing's syndrome leads to condition *hypernatremia.*

**Chloride ion ($Cl^-$):** It maintains proper hydration, osmotic pressure, normal electrolyte balance, acid-base balance and gastric HCl. It is obtained from common table salt and animal foods. It is completely absorbed, eliminates from blood by glomerular filtration and possibly reabsorbed by the kidney. Due to kidney diseases, diabetes and prolonged vomiting leads to deficiency of $Cl^-$ , condition is known as *hypochloremia.* Excessive $Cl^-$ intake leads to condition *hyperchloremia.*

**Role of Intracellular Electrolytes:**

**Phosphate ion ($HPO_4^{2-}$ and $H_2PO_4^-$):** It is predominant constituent of bones, teeth, $HPO42^-$ /$H_2PO_4^-$ buffer, cell phosphoproteins, phospholipids and cofactors of ATP, NAD, and FAD etc. It is obtained from milk and milk products, whole grains, legumes and egg yolk. It is easily absorbed from intestines and excreted mainly through urine. Excess and deficiency leads to condition *hyperphosphatemia* and *hypophosphatemia* respectively.

**Potassium ($K^+$):** It maintains acid-base and water balance. It is a buffer constituent, help in muscle contraction, membrane transport and carbon dioxide transport. It is obtained from fruits, vegetables, legumes and meat. It is rapidly absorbed, excreted by kidneys. Excess and deficiency leads to condition *hyperkalemia* and *hypokalemia* respectively.

**Magnesium ($Mg^{2+}$):** It is essential component of several enzymes involving phosphate metabolism, constituent of bones, teeth, help in protein synthesis and smooth functioning of neuromuscular function. It is not readily absorbed from GIT, unabsorbed $Mg^{2+}$ eliminated through faeces and absorbed portion is excreted through urine and intestinal secretions. Excess and deficiency lead to condition *hypermagnesemia* and *hypomagnesaemia* respectively.

**Sodium Chloride**

**Chemical formula:** NaCl

**Properties:** It is colorless crystals or white crystalline powder. It is odorless but possesses saline taste. It is freely soluble in water, soluble in glycerin and slightly soluble in alcohol.

**Preparation:**

(I) **From rock salt-** Sodium chloride is manufactured from underground rock salt deposits. Bore holes are drilled and water is run down to the rock salt straight. This dissolves sodium chloride to form its solution. The resultant clear saturated brine is then pumped above to the surface. This is then evaporated in triple effect evaporators to obtain sodium chloride.

(ii) **From seawater:** It is well known that seawater contains salts especially sodium chloride. Common salt has been manufactured from hundreds of years by evaporation of seawater in shallow pans or shallow tanks. This process is still used for manufacturing common salt.

**Storage:** It should be stored in tightly closed containers as it absorbs moisture.

**Uses:** Sodium chloride is primarily used as an electrolyte replenisher. It is an important salt present in the body fluids. A 0.9% aqueous solution of sodium chloride is isotonic with body fluids, known as normal saline solution

**Question No. 09. Give physical and chemical properties and uses of each compound.**

**(a) Borax (b) Alum (c) Boric Acid (d) Zinc sulphate (e) Zinc chloride**

**Ans. (a) Borax**

**Synonym:** Sodium Borate, Sodium Tetra borate

**Chemical formula:** $Na_2B_4O_7.10H_2O$

**Physical and chemical properties:** It is colorless transparent crystals or white crystalline powder, odorless with saline or alkaline taste. It is soluble in water and glycerin but insoluble in alcohol. Its aqueous solution is alkaline to phenolphthalein test solution due to hydrolysis.

$$Na_2B_4O_7 + 3H_2O \longrightarrow 2NaBO_2 + 2H_3BO_3$$

Sodium metaborate

If the solution is diluted further, sodium metaborate further hydrolyses giving rise to alkali and boric acid.

$$NaBO_2 + 2H_2O \longrightarrow NaOH + H_3BO_3$$

**Storage:** It should be stored in air tight containers in a cool place.

**Uses:**

1. It has antibacterial action but cause toxicity.
2. Its 1 to 2% concentration is used as eyewash, gargle, in mouthwash and as wet dressings.

**(b) Alum**

**Synonym**: Alum is Potash Alum, [Aluminium Potassium sulphate or Ammonia alum and others].

**Chemical formula:** $KAl(SO_4)_2.12H_2O$

**Physical and chemical properties:** Alum occurs as large, colourless crystals and as a white powder. It is odourless with sweetish strongly astringent taste. Its solutions are acidic to litmus paper. Alums are freely soluble in water, but slowly dissolve in glycerin and insoluble in alcohol. When heated, it melts and at about $200^0$ C looses it water of crystallization with the formation of the anhydrous salt. It is required to be stored in air tight containers.

**Storage:** It should be stored in air tight containers.

**Uses:**

1. Alum precipitates proteins and is a powerful astringent.
2. A 5% alum solutions are used by athletes to harden skin of feet and 15% powder in talc is
3. Used as Foot powder.

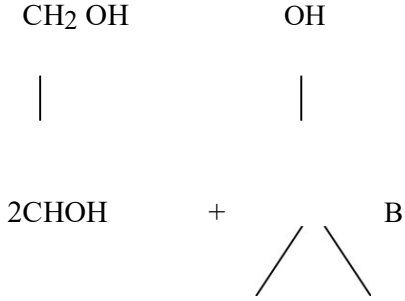
**(c) Boric Acid**

**Synonym:** Boracic acid

**Chemical formula:** $H_3BO_3$

**Physical and chemical properties:** It occurs as colourless or white crystals powder that is odourless and possess a slightly acidic bitter taste and sweetish after taste. It is soluble in water and alcohol and freely soluble in glycerin. A solution containing 1.9% acid is isotonic with body fluids.

Boric acid forms ester with glycerol.




$CH_2$ OH HO OH

(Glycerol) (Boric acid)

Boric acid on heating results in various dehydration products which depend upon temperature condition.

| | 100°C | | 160°C | |
|---|---|---|---|---|
| $4H_3BO_3$ | | $4HBO_2$ | | $H_2 B_4 O_7$ |
| | - $4H_2O$ | | - $H_2O$ | |
| Boric acid | | Metaboric acid | | Pyroboric acid |

**Storage:** It should be stored in well closed containers.

**Uses:**

1. Boric acid is a local anti-infective.
2. It is also used in dusting powders, local antiseptic creams, ointments.
3. Aqueous solutions used as mouth washes, eye lotions.
4. It has weak bacteriostatic and fungi static property.

**(d) Zinc Sulphate:**

**Synonym:** White Vitriol

**Chemical Formula:** $ZnSO_4$. $7H_2O$

**Physical and Chemical properties:** It occurs as colourless, transparent crystal or as crystalline powder. It is odourless, but it's taste metallic & astringent. It effloresces in dry air i.e. loses some part of its water of crystallization when exposed to air. It is very soluble in water & freely solution in glycerin, but insoluble in alcohol.

**Storage:** It should be stored in tightly closed containers.

**Uses**:

1. It is used as reflex emetics specially in narcotic poisoning (opium alkaloids

2. It is used as antiseptic & astringent as externally in powder & in lotions.
3. A 0.25% solution used as an ophthalmic astringent.

**(e) Zinc Chloride:**

**Synonym:** Butter of Zinc

**Chemical formula:** $ZnCl_2$

**Physical and chemical properties:** It is white or nearly white, odourless crystalline granules .It may also be found as porcelain- like masses or moulded into cylinders. It is highly deliquescent. It is very soluble in water and freely soluble in alcohol and glycerine. Usually its solution in water or in alcohol is slightly turbid due to the formation of zinc oxychloride.

**Storage:** It should be stored in air tight containers.

**Uses:**

1. It is used antiseptic, astringent to skin and mucous membrane.
2. It is used topically dentin desensitizer.
3. It is also used as mouthwashes for its antiseptic property.
4. It is used in ulcers.

**Question No. 10. What are Antidotes? Explain their mechanism & discuss cyanide poisoning in detail?**

**Ans.** A poison may be defined as any substance administered in whatever way (be mouth, infection, inhalation through skin or mucous membrane contact) produces ill- health, disease or death. An antidote is an agent that counteracts a poison. On the basis of mechanism of action, antidotes have been classified as (i) Physiological antidote (ii) Mechanical antidote (iii) Chemical antidote

**1) Physiological antidote:** Which counteract the effect of a poison by producing other effect, e.g. sodium nitrite, which converts heamoglobin into methaemoglobin in order to bind cyanide?

**2) Chemical antidote:** Which change the chemical nature of poison, e.g. sodium thiosulphate, which convert the systemically toxic cyanide into non toxic thiocyanate and sodium or calcium edentate which is a chelating agent used for heavy metal poisoning.

**3) Mechanical antidote**: Which prevent absorption of poison into the body e.g. (i) Activated charcoal, which adsorbs the poison prior to adsorption across the intestinal wall, (ii) copper sulphate which inactivate and precipitate the toxic material as insoluble salts?

**Cyanide Poisoning:** It requires special attention because it may occur by number of ways such as inhalation hydrocyanic acid, like fumigates or from the ingestion of soluble inorganic cyanide salt or cyanide releasing substances like cyanamide, cyanogens chloride, seeds of chokecberry, peach and other. Consumption of 300 mg of potassium cyanide may cause death.

**Signs & symptoms:** Nausea, drowsiness, dizziness, headache, hypotension, coma, convulsion & death. Death may occur within minute of inhalation of hydrogen cyanide while oral ingestion causes death in several hours.

**Process of cyanide poisoning in the body:** Cyanide readily combine with ferric ion ($Fe^{3+}$) of cytochrome oxidase which prevent electron transfer & thus stops the cellular respiration or oxidation reduction reaction.

**Treatment:** *Sodium nitrite and sodium thiosulphate* finds special place in the treatment of cyanide poisoning. Firstly injection of sodium nitrite is given which cause the oxidation of the ferrous ($Fe^{2+}$) ion of haemoglobin to the ferric ion of methaemoglobin. The methaemoglobin so formed then combines with serum cyanide that has not yet entered in the cell, to produce cyanmethaemoglobin. After 5 minutes, a slow intravenous infusion of sodium thiosulphate (50 ml in 10 minutes) is given. The thiosulphate ions react with cyanide ions set free owing to slow dissociation of cyanmethaemoglobin and form non-toxic thiocyanate ions. Usual dose & Antidote in cyanide poisoning used are:

1. Sodium Nitrite – 10 to 15 ml of 3% solution intravenously.
2. Sodium thiosulphate – 1g (range 500 mg to 2 g) in a 5 -10% solution intravenously.

**Question No. 11. (a) Define anions and cations. Describe identification test for $Na^+$, $K^+$, $Ca^{++}$, $Cl^-$, $SO_4^{--}$ and $HCO_3^-$.**
**(b) Describe limit test for Iron.**

**Ans.** (a) Cations may be defined as an atom gives its electrons to high electronegative atom and it changes in to cations. For example: $K^+$, $Ca^{++}$.

Anions may be defined as an atom which accept electrons from less electronegative atoms and change into anion. For example: $Cl^-$, $SO_4^{--}$

**Identification test for:**

**1. Sodium ($Na^+$):** Dissolve the substance (0.1 g) in the water (2ml) and add potassium carbonate (2ml, 15% w/v) and boil the solution, no precipitates are formed. To this add freshly prepared potassium antimonate

solution (4 ml) and boil. Cool and scratch the sides of the test tube to give a dense, white precipitates is formed.

$NaCl + KH_2SbO_4 \longrightarrow NaH_2SbO_4 + KCl$

Potassium Antimonate — Sod. pyroantimonate (white ppt.)

**2. Potassium ($K^+$):** (i) An aqueous solution of the substance is acidified with dilute acetic acid (1ml). On addition of a freshly prepared solution of sodium cobalt nitrate (10% w/v) an orange yellow ppt is formed immediately.

$2\,KCl + Na_3[CO(NO_2)]_6 \longrightarrow K_3Na[CO(NO)_2]_6 + 3NaCl$

Sodium cobalt Nitrate — Yellow ppt .

**3. Calcium ($Ca^{2+}$):** Dissolve a sample of the substance in minimum quantity of dilute HCl acid and neutralize with dilute sodium hydroxide solution or use 5 ml of the prescribed solution; add 5ml of ammonium carbonate solution; a white precipitate is formed which, after boiling and cooling the mixture ,is only sparingly soluble in ammonium chloride solution.

$CaCl_2 + (NH_4)_2CO_3 \longrightarrow 2NH_4Cl + CaCO_3$ (white ppt.)

**4. Chlorides ($Cl^-$):** Aqueous solution of substance containing chloride is acidified with dilute $HNO_3$ and treated with silver nitrate solution, when a cruddy white precipitates of silver chloride is formed.

$NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

White precipitates

**5. Sulphate ($SO^{--}_4$):** Dissolve a little amount of the substance in dilute HCl and add barium chloride solution (1 ml). A white precipitates of barium sulphate in formed.

$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2\,NaCl$

White precipitates

**6. Bicarbonates ($HCO_3^-$):** (i) When a solution containing bicarbonate is boiled, $CO_2$ is evolved which can be passed in lime water to give a white ppt of calcium carbonate boil.

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + CO_2 + H_2O$$

**Ans. (b) Limit test for Iron:** Limit test of iron depends upon the interaction of thioglycollic acid with iron in the presence of citric acid in the ammoniacal alkaline medium. This results in the formation of purple colored ferrous salt of thioglycollic acid.

Citric acid

$2\ HSCH_2COOH + Fe^{++} \rightarrow Fe(HSCH_2COO)_2 + 2H^+$

Thioglycollic acid — ferrous thioglycollate

1. Thioglycollic acid converts the iron impurities, if present, from the ferric form to ferrous form.
2. Thioglycollic acid forms the purple color with the ferrous form of iron in the ammoniacal alkaline medium.

**Note: All the reagents/solutions used in the test must be free from iron:**

**Procedure of limit test of iron-**

| Steps | Test Solution | Standard Solution |
|---|---|---|
| 01. | Dissolve 1gm of test preparation (Sodium Chloride) in 40 ml of distilled water in Nessler cylinder and label it as test solution. | Dissolve 2 ml of standard iron solution (20 ppm) in about 40 ml of distilled water in a Nessler cylinder and label it as standard solution. |
| 02. | Add 2 ml of 20% solution of Iron free citric acid. | Add 2 ml of 20% solution of Iron free citric acid. |
| 03. | Add 0.1 ml of Thioglycollic acid. | Add 0.1 ml of Thioglycollic acid. |
| 04. | Make the solution alkaline with iron free ammonia solution. | Make the solution alkaline with iron free ammonia solution. |
| 05. | Dilute up to 50 ml mark with distilled water, stir it with the help of glass rod and allow to stand for 5 minutes | Dilute up to 50 ml mark with distilled water, stir it with the help of glass rod and allow to stand for 5 minutes. |

Compare the purple colors in the two Nessler cylinders by viewing vertically downward, if the intensity of purple color in standard is more than that in test, the sample complies with limit test of iron.

**Question No. 12. Write short note on the following:**

**(a) Antimicrobials (b) Astringents (c) Protective and adsorbent (d) Antioxidants (e) Expectorant and Emetics**

**Ans. (a) Antimicrobials:** Antimicrobials are the agents used to destroy or inhibit the growth of pathogenic micro-organisms. They are normally ineffective in the sporing state of micro-organisms. But they may apply to the skin, body membranes and cavities. The **disinfectants** are employed for the application to inanimate objects and materials to get them rid of micro-organisms. An **antiseptic** is applied before all invasive procedure; antiseptics are also applied prophylactically to hands of surgeons, dentists, nurses and other others in their routine procedures. **Sterilization** is the complete destruction of all living micro-organisms, including bacterial spores. It can be achieved by physical method and by chemical (disinfectants). Example: Potassium permanganate ($KMnO_4$), Hydrogen peroxide ($H_2O_2$)

**Potassium permanganate**

**Chemical formula:** $KMnO_4$

**Properties:** It is a dark purple or brownish black granule that is odourless and soluble in water. Neutral or alkaline solution produces brown precipitate of manganese dioxide

**Preparation:** Manganese dioxide is fused with excess of potassium hydroxide in the presence of free supply of air or with the addition of some suitable oxidizing agent such as potassium nitrate or potassium chloride.

$$2\ KMn\ O_4 + H_2O \longrightarrow 2\ Mn\ O_2 + 2\ KOH + 3\ [O]$$

**Uses:** It is a strong oxidizing agent and is used for disinfectant, deodorant, gargles and mouthwashes.

**(b) Astringent:** Astringents are locally applied protein precipitate and reduce the cell permeability. Astringents are used as-

1. To check diarrhea.
2. Styptic: to arrest haemorrhage by promoting coagulation of blood and constricting small capillaries.
3. To constrict pores on the skin.
4. Promote healing and harden the skin.

Example: Alum, Zinc sulphate

**(c) Protectives:** Protectives are the compounds which are applied on the skin to protect ulcers or open wounds from irritation. These substances are insoluble and chemically inert. These may be applied to the surface to protect certain areas from irritation. Ideal protectives are biologically inactive. They generally absorb moisture and therefore also act as cutaneous desiccants. An ideal protective should be:-

(1) Insoluble in water (2) Chemically inert (3) Biologically inert (4) Available as fine particles

Protective and adsorbent is maximized with decreasing particle size because small particles offer a large surface area. Protective are generally used as dusting powders, suspension containing insoluble protective substance as lotions, ointments and creams. Some of the inorganic protective compounds and preparation described here: Example: Talc, Zinc oxide, Calamine, Zinc stearate, Titanium dioxide,

**Talc**

**Synonym:** Purified talc, Talcum, Soap stone

**Chemical formula:** $3MgO\ 4SiO_2.\ H_2O$ it is naturally occurring hydrated magnesium silicate and is called soapstone or French chalk.

**Properties:** It is a very fine white powder adheres to skin and free from grittiness, greasy to touch, odourless, tasteless. It insoluble in water, dilute acids or alkalies.

**Uses:**

1. It is a dusting powder, medicated with zinc oxide or boric acid.
2. It should not be applied on broken skin wounds or surgical gloves because it causes toxicity.
3. It is used as filtering media.
4. Talc also used as lubricant and as excipient in preparations of pills and tablets.

**Adsorbent:** Adsorbents are the substances that are used to absorb the undesirable substances on its surface. It is used in accidental or intentional poisoning, diarrhoea, sugar clarification and food poisoning. Adsorbent used internally for gastrointestinal irritation are different compounds. Example: light kaolin, activated charcoal.

**(d) Anti-Oxidants:** An antioxidant is an agent, which is added in any preparation to prevent oxidation and deterioration of the product. It is based on oxidation-reduction or redox reactions. Antioxidant should be handled with strong oxidizing agents. Examples are:-

1. Sulphur dioxide ($SO_2$)
2. Sodium bisulphate ($NaHSO_4$)
3. Sodium metabisulphate ($Na_2SO_5$)
4. Sodium thiosulphate ($Na_2S_2O_3.5H_2O$)
5. Sodium nitrite ($NaNO_2$)

**They act by two mechanisms: -**

1. Antioxidant is oxidized in place of active constituents.

2. If active constituents are oxidized, anti oxidant reduce it back to

normal. Example: Sulphur Dioxide

**Sulphur Dioxide**

**Chemical formula:** $SO_2$

**Properties:** It is colourless, non-flammable and an irritant odour. It forms addition product with halogen in presence of sunlight or camphor. It is a good reducing agent. It is stable even at high temperature & does not burn or support combustion in presence of catalyst and with the combination of oxygen it forms sulphur trioxide. It also gives reaction with halogens.

$SO_2 + Cl_2 \longrightarrow SO_2Cl_2$ [Sulphuryl chloride]

$SO_2 + F_2 \longrightarrow SO_2F_2$ [Sulphuryl fluoride]

**Uses:**

1. Mainly use as antioxidant.
2. Sulphur dioxide is gaseous in nature. Hence used in single dose injectables as antioxidants.
3. Sulphur dioxide in glycerine is used for sour throat, tonsillitis and skin infections.

**(e) Expectorant and Emetics**

**Expectorants:** Expectorants are the drugs used to help in removal of exudate from trachea, bronchi or lungs, & hence they are used in treatment of cough. They act by two ways.

1. By decreasing the viscosity of bronchial secretion and facilitating their elimination.
2. By increasing the amount the respiratory tract fluid. E.g. Ammonium chloride $NH_4Cl$ and Potassium iodide KI.

**Ammonium Chloride:**

**Synonym:** Amchlor

**Chemical formula:** $NH_4Cl$

**Preparation:** It is prepared by neutralizing acid with ammonia.

$NH_3 + HCl \longrightarrow NH_4Cl$

**Physical properties:** It is a colourless or white crystalline powder, odourless, and saline in test. Freely soluble in water and 5% solution is acidic.

**Uses:** It is used an expectorant, diuretics in lead poisoning and systemic acidifier in treatment of urinary infection.

**Emetics:** These are the agents, which are induces vomiting by produce irritation of G.I.T muscle and produce vomiting, example is antimony potassium tartarate. Some time its low dose is used in cough preparations. They probably stimulate flow of respiratory tract secretions. Emetics should not be use in condition of CNS depression, shock and in pregnancy e.g. antimony potassium tartarate.

**Antimony potassium tartarate**

**Synonym:** Antimony Pot. Tartarate

**Chemical formula:** $C_4H_4KO_7Sbk.1/2\ H_2O$

**Preparation:** It is prepared by mixing antimony trioxide [$Sb_2O_3$] with potassium acid tartarate in the ratio of 5: 6. The paste is made and kept aside for 24 hrs. Which is then boiled with water and liquid is filtered while hot. $Sb_2O_3 + 2\ C_4H_4O_6KH \longrightarrow 2\ C_4\ H_4\ O_7Sbk + H_2O$

**Physical properties:** It is a white crystalline powder, odourless, sweet in taste and soluble in 17 parts of water and insoluble in alcohol

**Uses:**

1. It is used as emetics also in Kala Azar disease gives by I.V. route, it should never be given by I.M because causes severe pain.
2. It also use in cough syrups in low dose.

**Question No. 13. Discuss in brief the dental products.**

**Ans.** Due to the habits of chewing betel leaves, tobacco and pan masala etc. common problems associated with teeth are formation of cavities, reduction of shining over teeth. These problems are overcome by the use of anti-caries agents, dentifrices and polishing agents.

**Common local dental products are:-**

**i) Anti-caries agents:** Dental carries occur due to action of lactic acid obtained from bacterial metabolism of dietary carbohydrates. The various anti carries agents are following (i) Sodium fluoride (ii) Stannous fluoride

**ii) Dentifrices and polishing agents:** It is also called cleaning agents. They are mixed with desensitizer and with polishing agents. Desensitizers used are strontium chloride and zinc chloride. The polishing agent used is calcium carbonate.

**iii) Abrasives:** They are used by the dentist in cleaning & polishing teeth e.g. pumice cavities i.e. dental cements.

**iv) Desensitizers:** They decrease hypersensitivity of teeth when applied on their surface e.g. ammonical silver nitrate solution.

**v) Mouth wash:** They are antiseptics medicated liquids use for cleaning the mouth e.g. hydrogen peroxide.

**Examples of dental products are:-**

(i) Sodium fluoride (NaF) (ii) Calcium carbonate ( $CaCo_3$) (iii) Dicalcium phosphate (iv) Zinc chloride ($Zncl_2$).

**Sodium fluoride:-**

**Chemical formula:** NaF

**Preparation:** It is prepared by passing hydrogen fluoride into a solution of sodium carbonate**.**

**Properties:** It is colourless, odourless, soluble in water and practically insoluble in alcohol.

**Usual dose:** 2.2 mg once a day for adults.

**Use:**

1. It is use for dental caries.

2. It may be added to water supplies.

3. 20% solutions in water may be applied to children teeth.

**Question 14 Define the buffer solution? How many types of buffer solution are there? Explain.**

**Ans. 14** Buffer solutions are defined as those solutions which are able to resists the change in pH value.

Buffer solution consists of a mixture of a weak acid or weak base and their salt respectively:-

**There are many type of Buffer solution:**

1) Acidic buffer 2) Basic buffer 3) Neutral buffer

**Acidic buffer solution:** The solution having a mixture of weak acid and its salt. For example: mixture of acetic acid and sodium acetate.

**Basic buffer solutions**: The solution having a mixture of weak base and its salt. For example: mixture of ammonium hydroxide and ammonium chloride.

**Neutral buffer solution**: The solution having a mixture of weak acid or weak base. For example: mixture of acetic acid and ammonium hydroxide. .

**Question No.15. Write down:-**

**(a) Chemical formula and use of laughing gas (b) Pharmaceutical uses of nitrogen (c) Composition of soda lime (d) Buffer capacity (e) Temperature range for storage of drugs under cold condition and cool condition (f) Differentiate very soluble and freely soluble salts.**

**Ans.**

**(a) Chemical formula and uses of laughing gas**

**Chemical formula:** $N_2O$

**Uses:** It is used by inhalation for operation of short duration like dental extractions, minor operations of boils and abscesses. It is often used in conjunction with local anaesthetics and muscle relaxants.

**(b) Pharmaceutical uses of nitrogen**

1) Nitrogen can be used to protect chemicals, reagents and pharmaceuticals from air oxidation by displacing the air in the reaction vessels and containers, e.g. cod liver oil, olive oil and castor oil etc.

2) Liquid nitrogen is used in food- freezing process, and in laboratory as a coolant.

3) Liquid nitrogen is used in cryoscopic surgery to remove some tumours.

4) Other uses of nitrogen are in manufacture of ammonia, nitric acid, nitrates, cyanindes, explosives etc.

5) It is also used to replace air in containers of parentrals, solution for topical applications and injections.

**(c) Composition of soda lime**

The main components of the soda lime are-

1. Calcium hydroxide Ca $(OH)_2$ (about 75%)
2. Water, $H_2O$ (about 20%)
3. Sodium hydroxide, NaoH (about3%)
4. Potassium hydroxide, KOH (about 1%)

**Uses:-** (i) It is used as pharmaceutical aid for adjusting pH of solutions.

(ii) Sodium hydroxide is a powerful caustic and has been used to remove warts. Its 2.5% solution in glycerol may be used as a solvent for removing superficial skin.

**(d) Buffer capacity:** Buffer solution resist change in pH upon the addition of strong acids or strong bases. The buffering action is measured in terms of buffer capacity. Buffer capacity is defined as the moles of strong acid or strong base required to change the pH of one litre of buffer solution by one unit.

**(e) Temperature range for storage of drugs under cold condition and cool condition:**

**Cold:** Any temperature not exceeding 8°C and usually between 2°C and 8°C will provide cold conditions. A refrigerator is a cold place in which the temperature is maintained thermostatically between 2°c to 8°c.

**Cool:** Any temperature between 8°C and 25°C will provide cool conditions. An article for which storage in a cool place is directed, may alternatively be stored in a refrigerator, unless otherwise specified in the individual monograph

**(f) Differentiate very soluble and freely soluble salts**

**Solubility-** According to I.P 2010, solubilities of the substance at 1 to 30°C are mentioned in the following terms:

**Very soluble**: A substance is said to be very soluble, if volume of solvent required for dissolving 1 part of solute is less than 1 part.

**Freely soluble**: A substance is said to be freely soluble, if volume of solvent required for dissolving 1 part of solute is less than 1 to 10 parts.

**Question No. 16. Write storage condition of following compounds: iodine, normal saline solution, chlorinated lime, sodium hydroxide & also explain the reason.**

**Ans. Iodine-** It should be stored in well- closed bottles fitted with glass stoppers because iodine is volatile and its vapours reacts both cork and rubber.

**Normal saline solution: -** It should be stored in tightly closed containers as it absorbs moisture. Solutions on storage may cause the separation of small solid glass particles from glass containers. Solution containing such particles must not be used and should be discarded.

**Chlorinated lime: -** It should be stored in tightly closed containers because on exposure to air, it slowly decomposes with the loss of chlorine. This change is due to the action of atmospheric carbon dioxide and moisture.

**Sodium hydroxide: -** As it is highly deliquescent and as it also readily absorbs carbon dioxide from air, therefore, it must be stored in tightly closed containers. The stoppers of glass may get jammed due to the formation of sodium silicate. Hence, non-reactive glass or plastic materials are to be preferred.

**Question No.17. (a) Write note on physiological acid base balance.**

**Ans. (a) Physiological acid-base balance**

All body fluids have definite pH values which must be maintained within relatively narrow limits. The normal range of pH values of few selected fluids are:

| | | | |
|---|---|---|---|
| Blood | 7.4-7.5 | Duodenal fluid | 5.5- 7.5 |
| Saliva | 6.4-7.4 | Gall bladder bile | 5.5-7.5 |
| Urine | 4.5-8.0 | Gastric juice | 1.5-1.8 |

There are three regulatory mechanisms which maintain the pH of the each system and equilibrium with one another. These are -

(1) Buffer (2) Respiratory mechanism (3) Renal regulation

**(1) Buffers:** Buffers are the chemical systems capable of maintaining a constant pH, e.g. phosphates, bicarbonates and some proteins which are able to bind free $H^+$ or $OH^-$ ion and prevent a change in pH. Three major systems of buffering in the body are-

i) Carbonic acid/ bicarbonate which mainly occurs in plasma and kidney.
ii) Monohydrogen phosphate / dihydrogen phosphate found in cells and kidney.
iii) Protein buffer system.

Proteins are composed of amino acids bound together by peptide linkage.

**(2) Respiratory mechanism:** When respiration is decreased, there is an accumulation of $CO_2$ in the body which uses up the alkali reserve of the blood resulting in the acidosis. On the other hand, if there is over-breathing which results in excessive excretion of $CO_2$, the condition of alkalosis may be develop. Thus, acidity and $CO_2$ increases are both powerful stimulants of respiratory mechanisms and cause an increase in the rate and depth of respiration. The $H_2CO_3$ is converted to $CO_2$ and water the $CO_2$ rapidly breathed out. On the other hand, an increase in base, leads to a decrease in acidity and $H_2CO_3$ content.

**(3) Renal regulation**: Kidneys have the ability to form ammonia which combines with the acids produced during metabolism and is excreted in the urine. The pH of urine is highly variable between 4.8 to 8.0.

**Disturbance in acid- base balance-** The buffer, respiratory and excretory systems of the body work together to maintain the acid-base balance of the body, so that the pH range of various body fluids remain within normal but narrow limits. A primary defect in elimination of $CO_2$ or a metabolic disorder can lead to alteration of pH of blood beyond physiological limits and these disturbances in acid-base balance are classified accordingly.

**(1) Respiratory acidosis:** The $H_2CO_3$ content of plasma is increased due to interference with the elimination of $CO_2$ by lungs. This occurs mainly in conditions such as congestive heart failure, pneumonia and poisoning with barbiturates or narcotic drugs which depress the respiratory centre.

**(2) Respiratory alkalosis:** There is a fall of $H_2CO_3$ level of plasma due to hyperventilation in the lungs. This occurs mainly in fever, anoxia, salicylate poisoning and at high altitudes.

**(3) Metabolic acidosis:** The $HCO_3^-$ fraction of plasma is lowered in conditions such as renal failure, diabetes mellitus and severe dehydration due to diarrhea and vomiting. Compensation to some extent in initial stages occurs by increased respiration whereby more $CO_2$ is eliminated to maintain the $HCO_3^-/H_2CO_3$ ratio.

**(4) Metabolic alkalosi**s: An increase in the bicarbonate content of plasma due to ingestion of large volume of alkalis in the treatment of peptic ulcer and vomiting due to high intestinal obstruction are the two main causes. Compensation to some extent is attempted by a depression of respiration and an excretion of alkaline urine by kidneys.

**Question No.18 (a) Write down the theory of limit test for chloride.**

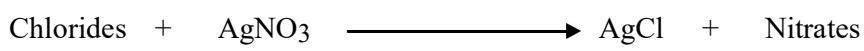
**(b) Name four official compounds of calcium and explain physiological roles of calcium in human body.**

**Ans. (a) Limit test for chloride:-** Limit test for chloride depends upon the interaction of chlorides with silver nitrate in the presence of nitric acid. This results in the precipitation of chloride as silver chloride. When only small quantity of chloride ions are present, silver chloride appears as opalescence and not as precipitate.

**Limit test for chlorides in magnesium sulphate I.P**

| Test | Standard |
|---|---|
| 1. Take 8.0 ml of solution A (prepared by dissolving 1. 5.0 g in sufficient carbon dioxide free water and transfer it to a nessler cylinder labeled as test. | To take 10 ml of chloride standard solution (25 ppm Cl). (This is prepared by diluting 5 volumes of 0.0824 percent w/v solution of sodium chloride to 100 volumes with water.) |
| 2. Add 10 ml of dilute nitric acid. | 2. Add 10 ml of dilute nitric acid. |
| 3. Dilute to 50 ml mark with distilled water. | 3. Dilute to 50 ml mark with distilled water. |
| 4. Add 1 ml of 0.1 M solution of silver nitrate. | 4. Add 1 ml of 0.1 M solution of silver nitrate. |

Chlorides present in pharmaceutical substance in very small quantities as an impurity and, therefore silver chloride appears as opalescence which is compared under uniform condition of illumination with standard opalescence in nessler cylinder.




**Ans. (b) Physiological role of calcium in human body:-** Calcium is one of the essential elements required for various functions of body. About 90% of the body calcium is found in bones as calcium carbonate and phosphate. The ionic form of calcium is involved in the various physiological activities. The calcium ions are essential for maintenance of some the important body functions for example:

1. The cation is essential for normal functioning of automatic nervous system and voluntary systems.

2. Calcium is necessary for normal cardiac function.

3. It is important factor in coagulation of blood and cell membrane permeability.

4. It is important for the formation of certain tissues and bones.

When the deficiency of ionized calcium in blood, the condition is known as hypocalcaemia.

The official compounds of calcium are discussed below:

**1. Calcium acetate**

**Chemical formula:** $C_4H_6CaO_4$

**Properties:** It is a white powder almost colourless and hygroscopic in nature. It is soluble in water but slightly soluble in alcohol.

**Storage:** As it is hygroscopic in nature, it is kept in a well closed container in dry place.

**Uses:** It is one of the ingredients of solutions used for haemodialysis and peritoneal dialysis. The haemodialysis solutions are solutions of electrolytes in concentration similar to those of normal extracellular body fluids and glucose may be included in such formulations.

**2. Calcium gluconate**

**Chemical formula:** $C_{12}H_{22}O_{14}Ca.H_2O$

**Properties:** It occurs as a white crystalline powder or as white granules. It is odourless and almost tasteless. It is slowly soluble in cold water but is freely soluble in boiling water. It is insoluble in alcohol.

**Storage:** It should be stored in well close container.

**Uses:** It is used as a calcium replenisher. It is an important source of calcium in the treatment of hypocalcaemic tetany and in other calcium deficiency conditions stated under introduction. It administered orally as tablets and in the form of injections. Calcium gluconate tablets are used extensively in supplementing the diet of convalescent and expectant mothers.

**3. Calcium hydroxide**

**Chemical formula:** $Ca(OH)_2$

**Properties: -** It is soft white powder with an alkaline and slightly bitter taste readily absorbs carbon dioxide from air forming calcium carbonate. It is sparingly soluble in water. It is much more soluble in solutions of sugar and of glycerol, but is insoluble in alcohol.

**Storage:-** It should be stored in air tight containers to prevent its interaction with atmospheric carbon dioxide.

**Uses: -** Calcium hydroxide is an antacid and astringent. It is given orally as solutions which, when added to milk, prevents the formation of large clot of curd in the stomach. As an astringent, it is extensively used by betel leaf chewers. Its carbon dioxide absorbing property is useful in certain types of gas-traps.

**4. Calcium carbonate**

**Chemical formula:** $CaCO_3$

**Properties:** It is a fine white, micro crystalline powder, odourless and tasteless. It is stable in air. It is nearly insoluble in water and alcohol.

**Uses:** It acts as non- systemic antacid. It produces a rapid onset of action. The antacid is due to its basic property and is not of atmospheric nature as of aluminium compounds. It is also used dentifrices.

**Question no. 19. What is the principle of Geiger muller counter?**

**Answer: Geiger- Muller counter**- It is one of the oldest radiation detector types in existence, having been introduced by Geiger and Muller in 1928. It is referred to as G-M couter or simply tube. The simplicity, low cost and of ease of operation of these detector have lead to their continued use to the present time. They detected α, β and γ radiations. It consists of a cylinder made up of stainless steel or glass coated with silver on the inner side which acts as cathode. Coaxially inside the tube a mounted fine were works as an anode. It

is having the mixture of ionizing gas which contains a small proportion quenching vapour. The functions of quenching vapour are to prevent the false pulse and to absorb the photons emitted by excited atoms and molecules returning to their ground state.Chlorine, bromine, ethyl alcohol and ethyl formate are commonly used quenching agents. Radiation when enters the tube through a thin section of outer wall causes ionization of atoms of the gas. When a high voltage is maintained between two electrodes, the electrons and charged ions are attracted by the anode and cathode respectively. Each particle of radition produces a brief flow or pulse of current which can be recorded by a scalar.