Chapter 1

Introduction to Pharmaceutical Chemistry and Quality Control of Drugs and Pharmaceuticals

1 Define Pharmaceutical Chemistry. Give the scope and objectives of it.

☞ **Pharmaceutical Chemistry:**

It is the branch of pharmaceutical science that deals with the study of chemistry of medicinal substances.

☞ **Scope and objectives:**

1. It helps to impart the basic knowledge of the chemical structure, storage conditions and medicinal uses of organic and inorganic chemical substances, used as drugs and pharmaceuticals.
2. It helps to study pharmacological uses, doses and stability of the drugs.
3. It helps to study different formulations available in the market with their brand names.
4. It helps to study impurity testing and basic quality control testing of the drugs and pharmaceuticals.
5. It is focussed on quality aspect of medicine and aims to assure fitness for purpose of medicinal products.

2 Define the term "pharmacopoeia". Give its Importance.

☞ **Pharmacopoeia:**

Pharmacopoeia is the official book of standards published by respective Governments containing, the list of drugs, pharmaceuticals, their formulae, identification, standardisation, dose, uses, etc.

The word pharmacopoeia is derived from the Greek Words:

'*Pharmacon*' means a 'drug'

'*Poeio*' means 'To make''

- **Importance/Object/Need/Purpose/Scope of pharmacopoeia:**
  (i) To ensure uniformity in composition of drug.
  (ii) To ensure purity of drug.
  (iii) To ensure potency of drug.
  (iv) To study official preparations of drugs.
  (v) To refer procedures for testing of drugs.
- **List of Pharmacopoeia Published:**
  (1) First edition in 1955
  (2) Second edition in 1966
  (3) Third edition in 1985
  (4) Fourth edition in 1996
  (5) Fifth edition in 2007
  (6) Sixth edition in 2010
  (7) Seventh edition in 2014
  (8) Eighth edition in 2018

3 Define 'Monograph'. Give the contents of monograph.

☞ **Monograph:**

Monograph means detailed systematic account of the drug with reference to title, synonym, description, category, identification, official preparations, etc.

- **Contents of Monograph:**

The monograph gives following details of an official compound.

1. **Title:** It is an approved name of drug or its preparation.
2. **Synonym:** It is an alternative name of the drug.
3. **Description:** It gives physical description of the substances like crystalline or amorphous nature, colour, odour, taste, etc.
4. **Identification:** Qualitative tests, coloured reactions, precipitating tests, gas evolution are used for identification of drugs.
5. **Test for purity:** The upper and lower limits of purity are expressed numerically.
6. **Dose and dosage:** The usual dose and route of administration are mentioned. Usual strength may be given for pharmaceutical dosage forms.
7. **Storage:** Storage conditions are important to take precautions in relation to effect of atmosphere, moisture heat, light, etc.

Cold	–	Between 2°C and 8°C
Cool	–	Between 8°C and 25°C

Warm	–	Between 30°C and 40°C
Excessive heat	–	Any temperature above 40°C

8. **Solubility:** Solubility of the medicinal compounds is expressed as: Approximate solvent volume in ml for 1 g of solute.
   - Very soluble – Less than 1
   - Freely soluble – From 1 to 10
   - Soluble – From 10 to 30
   - Sparingly soluble – From 30 to 100
   - Slightly soluble – From 100 to 1000
   - Very slightly soluble – From 1000 to 10,000
   - Insoluble – More than 10,000
9. **Limit of impurities:** Limit tests are important to determine the permissive limits of tolerance.
10. **Container:** Specifications of container such as light resistant, well closed, tightly closed hermetically sealed containers are mentioned.
11. **Labelling:** Labelling of the drug or pharmaceutical preparations is as per the Drugs and Cosmetics, Act, 1940.
12. **Physical constants:** Physical constants like melting point, boiling point, refractive index, optical rotation, viscosity, etc. are mentioned in pharmacopoeia for standardisation of pharmaceuticals.
13. **Assays:** The estimation of percentage purity of the active chemical constituent is known as assay.
    The methods of quantitative analysis (assay) are mentioned in pharmacopoeia.
14. **Category:** It represents the main pharmacological action/therapeutic use of the drug.

4 Define quality control. Give functions and importance of quality control.

☞ Quality Control

It is the day-to-day process of controlling quality of every incoming material till the finished product quality.

Functions of Quality Control

- Analysis of raw materials
- Analysis of packaging materials
- Analysis of in-process products

- Analysis of final dosage forms
- Analysis of batch products (periodic analysis)
- Recording the results of analysis in a standard format

Importance of Quality Control

- To avoid toxic and unwanted effects of impurities
- To avoid technical difficulties during manufacturing
- To maintain safety and effectiveness of products
- To maintain product with adequate physical and chemical stability
- To ensure quality drugs for consumption to the patients
- To maintain purity of product and thus protect public health
- To help in maintenance of quality of product with better utilization of labours and machines
- It helps in adjustment and setting of machineries
- It helps in product development and in research with control over wastes and scraps
- It helps in decreasing the cost of manufacturing so that cost of final product may be decreased.

5 Define quality assurance. Give its functions.

☞ **Quality Assurance:**

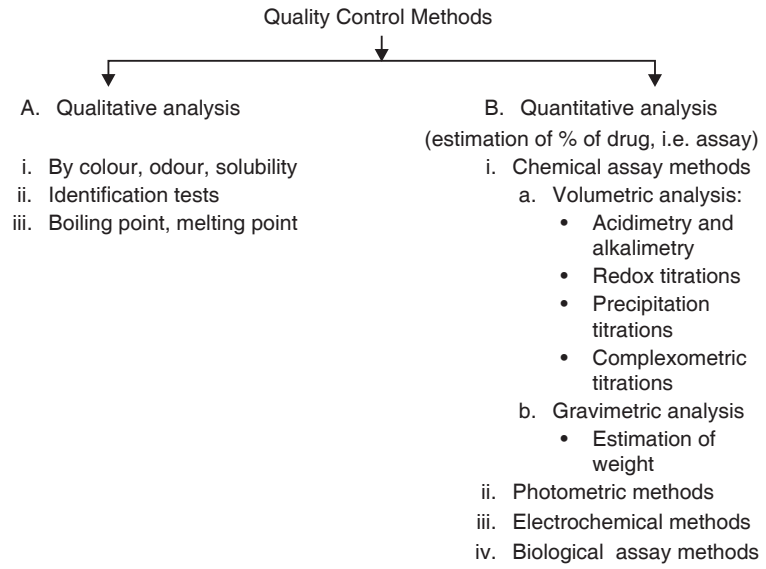
It is the department which includes a total quality control, government regulations, company standards and development of standard operating procedures of analysis.

Functions

- Development of standard operating procedures and supply to every department of the company.
- It has a responsibility of "total quality of the products".
- It gives guidelines during adjustment and setting of the machineries.
- It helps to maintain quality of products with better utilisation of labours and machines.
- It helps in product development and research.

6 What are different methods used for quality control in pharmacy?

Quality control is to analyse a drug for quality and quantity. Following are various methods used for quality control:



7 Write in short about (a) "Significant Figures", (b) Precision, (c) Accuracy, (d) Absolute error, (e) Standard Deviation.

☞ (a) Significant Figures

Significant figures can be defined as the number of digits necessary to express the results of measurement consistent with the measured precision.

- It should be clear that zeros are used to denote the significant part of measurement.
- Thus, zero within a number like 25.05 and 1350 are significant as they express the exact quantity while in the quantity 0.00035 kg the zero before the point, is not significant, but shows the order of magnitude of the other digits.

(b) Precision:

- The precision means the degree of reproducibility or agreement between repeated measurements.
- Precision is the variability among replicate measurements, i.e how close the values of the results of replicate measurements are to each other.
- More the measurements, better is the precision and error will be smaller.

(c) Accuracy:

- An accuracy means closeness of an experimental result with true value or actual result.
- Accuracy is the differences between the true value and the value of experimental result.
- An experimental procedure may be highly precise, but because of some errors, the results could be inaccurate.
- Accuracy expresses the correctness of the measurement.

(d) Absolute Error (Eabs):

- "The absolute error of a determination is the difference between the observed or measured value".
- The absolute error is a measure of the accuracy of the measurement.
- The absolute error may be positive or negative.

  Absolute Error (Eabs) = (X – T),
  where X – measured or observed value
  T – accepted or true value.

(e) Standard Deviation/root mean square deviation (S/SD):

- It is one of the most common statistical terms used in analytical chemistry.
- The standard deviation is a measure of how spread-out numbers is, in other words, it is a measure of precision.
- It is abbreviated as S or SD.

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{n - 1}},$$

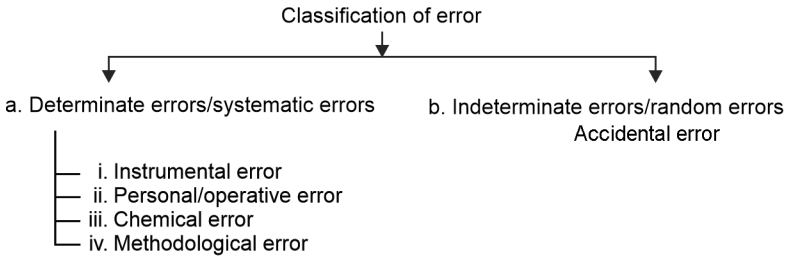
where,
n—Number of measurements.

8 Write a note on "errors in analysis".

☞ Error:

Error is the difference between measured value and true value.

- Though the measurements are made by different methods of quality control, systematically and carefully but there is some degree of error.
- An error is associated with every measurement.
- The analyst must try to reduce the magnitude of the error to an accepted level.



a. *Determinate errors/systematic errors*: These types of errors are determinable and can be either avoided or corrected.
   i. *Instrumental error*: It is caused by use of faulty equipment.
   ii. *Personal error*: It is the error made by person doing analysis.
   iii. *Chemical error*: This error is due to impurities in chemicals.
   iv. *Methodological error*: It arises due to faulty method used for analysis, e.g. incomplete reaction, incomplete heating.

b. *Indeterminate errors/random errors*: These errors are also called accidental errors. These errors are fluctuating and do not have a definite value and are difficult to locate. They arise due to unknown and uncertain measurement or may be due to differences in judgment and skill of analyst.
   Hence, elimination of these errors is impossible to the analyst.

9 Define impurity. Discuss various sources of impurities in pharmaceutical substances. (S.22, 23, 24, W.22, 23)

☞ Impurity:

Impurity is an undesirable matter which may or may not be toxic but present in the pharmaceutical substances.

Sources of Impurities

- *Raw material used in manufacture*: If raw material contains an impurity, then this impurity gets incorporated into the final product.
  Impurities like lead, arsenic, etc. are present in the raw materials and hence found in substances as impurities, e.g. if copper foils are contaminated with arsenic, the final product $CuSO_4$ may contain arsenic impurity.
- *Reagents used in manufacturing process*: If reagents contain impurity, it is transferred to the final product, e.g. calcium

carbonate is prepared by using calcium chloride and sodium carbonate. Thus, it may contain impurity of sodium carbonate or calcium chloride.

- *The process used in manufacturing*: There are a number of chemicals which are manufactured from different raw materials by different methods or processes. Due to this some impurities get incorporated into the materials during manufacturing process.

  Tap water is generally used in various manufacturing processes. Tap water contains chlorides, calcium, magnesium as impurities thus gets incorporated in the products.
- *Material of plant*: Equipment and vessels used in manufacturing process are made of metals like copper, iron, aluminium, zinc but these metals are introduced as impurities by the solvent action of raw materials. Nowadays, these metals are replaced by stainless steel.
- *Intermediate products*: Incomplete reactions produce unwanted intermediate products which may be the impurity in the final products.
- *Adulteration/accidental substitution*: The cheap substances are added in pure substances as a substitute and, therefore, added substances act as an impurity in pure substance, e.g. sodium bromide is an impurity in potassium bromide as the sodium salt is cheaper.
- *Inadequate storage/defective storage*
  i. Many chemical substances undergo changes due to careless storage, thus may develop impurity in it.
  ii. Stored products may become contaminated with dust, the bodies of insects and even animals and insect excreta.
  iii. Many substances when exposed to light, air and moisture, may change the colour, properties and shelf life of products, e.g.
  - Due to careless storage, ferrous sulphate is slowly converted into insoluble ferrous oxide by air and moisture.
  - Surgical solution of chlorinated soda deteriorates upon exposure to light and heat. Hence, it should be stored in well closed amber-coloured bottles in cool place.
  - Chloroform decomposes in presence of light and air and forms a phosgene gas which is toxic. So, it should be stored in well closed amber-coloured bottle.
  - Bismuth carbonate is blackened on long exposure to sunlight.

- *Manufacturing hazards*: Impurity may get incorporated at various stages of manufacturing.
  i. *Particulate contamination*: It involves the pieces of plastic, threads in the product and also come from improperly cleaned equipment and also due to wear and tear of equipment.
  ii. *Process error*: It involves incomplete reactions during processing.
  iii. *Cross-contamination*: Handling of powders, granules and tablets may produce considerable air-borne dust. This airborne dust may lead to cross-contamination of other products.
  iv. *Microbial contamination*: Liquids or creams may be contaminated due to bacteria and fungi from atmosphere.
  v. *Packing errors*: The products of similar appearance such as tablet of same size, colour and shape may be packed in the similar containers and can cause danger due to mislabelling.

10 What are different types of impurities commonly occurring in pharmaceuticals?

- *Toxic impurity*: If impurity is present above the prescribed limit and produces toxic effect on the body, it is called toxic impurity, e.g. lead, arsenic impurities.
- *Harmless impurity*: Some impurities are harmless but if present above the prescribed limit, they lower active strength of substances, e.g. impurities of sodium salts in potassium salts.
- *Impurity affecting storage property*: For example, presence of small amount of moisture in the drug may reduce flow property and affect the storage.
- *Impurity causing technical difficulties*: Impurities cause many technical problems during manufacturing, e.g. picking and sticking defects may occur in tablet manufacturing.
- Impurities affecting taste, odour and appearance of the product.
- Impurities even when present in traces, may show a cumulative toxic effect after certain period.
- Impurity which lowers the shelf life of the substances.

11 Discuss the effects of impurities.

☞ **Effects of Impurities:**

- Impurities may produce toxic effect if present above certain limits.
- Impurities, even in small quantity, may show cumulative toxic effect after a certain period.
- Impurities may reduce active strength of the substance.
- Impurities may change physical and chemical properties of the substance and thus making it medically useless.
- Impurities may cause technical difficulties in the formulations.
- Impurities may produce incompatibility with other substances.
- Impurities may lower the shelf life of the substance.
- Impurities may affect and change the colour, odour, taste and appearance and make the substance unhygienic.

12 Define the term "limit tests". Explain BSR.

☞ **Limit Tests:**

These are qualitative tests used to identify the small amounts of impurities present in the substances.

BSR (Barium Sulphate Reagent)

It is used in limit tests for sulphate IP 85.

- *Composition of BSR*
  i. $BaCl_2$ solution.
  ii. Sulphate-free alcohol.
  iii. Potassium sulphate solution.
- *Uses of ingredients*
  i. $BaCl_2$ reacts with impurity to form $BaSO_4$.
  ii. Alcohol prevents supersaturation.
  iii. Potassium sulphate increases the sensitivity of test.

13 Describe the limit test for chloride IP.

☞ **Principle/Concept:**

Chloride impurity reacts with silver nitrate to form a white precipitate of silver chloride in the presence of dilute HNO_3. It is observed as opalescence.

Reaction

$$Cl^- + AgNO_3 \xrightarrow{\text{dilute } HNO_3} AgCl \downarrow + NO_3^-$$

Silver nitrate — Silver chloride (opalescence)

Note

- Purified water is used for dilution and it is free from dissolved gas and impurities.
- Standard solution is prepared as it gives maximum permissible limit for comparison.
- Dilute HNO_3 is used as it avoids the reaction of acidic radicals other than chloride with that of $AgNO_3$.
- The opalescence is directly proportional to amount of chloride impurity present in the substance.
- If test substance is coloured ($KMnO_4$), then first it is decolourised and then followed for limit test.

Procedure

Limit test for chloride IP 66

Test solution	*Standard solution*
i. Weight of substance as per monograph. ii. 1 ml of dilute HNO_3. iii. Dilute up to 50 ml with water. iv. Add 1 ml of 5% $AgNO_3$ solution.	i. 1 ml of 0.01 N HCl solution. ii. 1 ml of dilute HNO_3. iii. Dilute with water up to 50 ml. iv. Add 1 ml of 5% $AgNO_3$ solution.

Limit test for chloride IP 85

Test solution	*Standard solution*
i. Weight of substance as per monograph. ii. Add 10 ml of dilute HNO_3. iii. Add water up to 50 ml. iv. Add 1 ml of 1% $AgNO_3$ solution.	i. 1 ml of 0.0585 w/v of NaCl solution. ii. Add 10 ml of dilute HNO_3. iii. Add water up to 50 ml. iv. Add 1 ml of 1% $AgNO_3$ solution.

Limit test for chloride IP 96

IP 96 prescribes use of 1 ml of 0.1 M $AgNO_3$ solution. The chloride impurity is generally 25 parts per million. Standard chloride solution is taken 10 ml for the preparation of standard solution.

Stir both the solutions and keep it aside for 10 minutes.

Remarks

If opalescence produced in test solution is less than standard solution, substance passes the limit test for chloride IP.

14 Describe the limit test for sulphate IP. (S.24)

☞ Principle/Concept:

Sulphate impurity reacts with barium chloride in the presence of dilute HCl to form white precipitation of barium sulphate. It is observed in the form of turbidity.

Reaction

$$\underset{\text{Barium chloride}}{SO_4^{--} + BaCl_2} \xrightarrow{\text{dilute HCl}} \underset{\text{Barium sulphate precipitation}}{BaSO_4 \downarrow} + 2Cl^-$$

Note

- Purified water is used for dilution and it is free from dissolved gas and impurities.
- Standard solution is prepared as it gives maximum permissible limit for comparison.
- Dilute HCl is used as it avoids the reaction of acidic radicals other than sulphate with that of $BaCl_2$.
- Barium sulphate reagent: It is used according to IP 85. It contains $BaCl_2$, K_2SO_4 and alcohol. Barium chloride reacts with sulphate impurity. Alcohol prevents supersaturation. Potassium sulphate increases rate of reaction and sensitivity.

Procedure

Limit test for sulphate IP 66

Test solution	*Standard solution*
i. Weight of substance as per monograph.	i. 2.5 ml of 0.01N H_2SO_4.
ii. 1 ml of dilute HCl.	ii. 1 ml of dilute HCl.
iii. Add water up to 50 ml.	iii. Add water up to 50 ml.
iv. Add 1 ml of $BaCl_2$ solution.	iv. Add 1 ml of $BaCl_2$ solution.

Limit test for sulphate IP 85

Test solution	*Standard solution*
i. Weight of substance as per monograph. ii. Add 2 ml of dilute HCl. iii. Add water up to 45 ml. iv. Add 5 ml of BSR.	i. 1 ml of 0.1089% w/v of K_2SO_4. ii. Add 2 ml of dilute HCl. iii. Add water up to 45 ml. iv. Add 5 ml of BSR..
Limit test for sulphate IP 96	
It prescribes ethanolic sulphate standard solution which gives 10 ppm sulphate impurity and also use of 25% w/v barium chloride solution. Stir well both the solutions and keep it aside for 5 minutes.	

Remarks

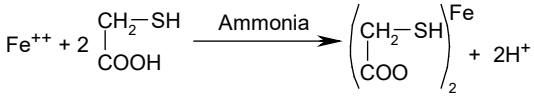
If turbidity produced in test solution is less than standard solution, sample comply with the limit test for sulphate IP.

15 Describe the limit test for iron IP. (W.23)

☞ **Principle/Concept:**

Iron impurity reacts with thioglycolic acid in the presence of dil. ammoniacal alkaline medium to form purple-coloured ferric thioglycate.

Reaction



Thioglycolic acid Ferric thioglycate (purple-coloured)

Note

- Purified water is used for dilution purpose and it is free from dissolved gases and impurities.
- Standard solution is prepared as it gives maximum permissible limit for comparison.
- Ammoniacal alkaline medium is necessary for reaction of thioglycolic acid with iron impurity.
- Citric acid prevents precipitation of iron with ammonia.
- Thioglycolic acid is used because it reacts with ferrous form of iron and converts it into ferric form. Thus, it forms purple colour.

Procedure

Limit test for iron IP 66

Test solution	*Standard solution*
i. Weight of substance as per monograph.	i. 2 ml of standard iron solution (0.173 g of ferric ammonium sulphate + 1.5 ml of HCl).
	ii. Add 40 ml of water.
ii. Add 40 ml of water.	iii. Add 2 ml of citric acid.
iii. Add 2 ml of citric acid (20%).	iv. Add ammonia to adjust. alkaline pH.
iv. Add ammonia to adjust alkaline pH.	v. Adjust volume up to 50 ml with water.
v. Adjust volume up to 50 ml with water.	

Limit test for iron IP 85

Test solution	*Standard solution*
i. Weight of substance as per monograph.	i. 2 ml of standard iron solution (0.1726 g of ferric ammonium sulphate + 10 ml of 0.1 N H_2SO_4).
ii. Add 40 ml of water.	ii. Add 40 ml of water.
iii. Add 2 ml of citric acid.	iii. Add 2 ml of citric acid.
iv. Add ammonia to adjust alkaline pH.	iv. Add ammonia to adjust alkaline pH.
v. Adjust volume up to 50 ml with water.	v. Adjust volume up to 50 ml with water.

Stir well and keep aside for 5 minutes and observe.

Remarks

If purple colour obtained in test solution is less than standard solution, sample passes limit test for iron IP.

16 Describe the limit test for heavy metals IP.

☞ Principle/Concept:

Heavy metal impurity reacts with hydrogen sulphide/sodium sulphide in presence of acidic/alkaline medium respectively to form brown precipitation of metal sulphide.

Reaction

i. $M + H_2S \longrightarrow MS + 2H^+$

ii. $M + NaS \longrightarrow MS + 2Na^{++}$

(Metal sulphides) (brown precipitations)

Note

- Purified water is used for dilution purpose and it is free from dissolved gases and impurities.
- Standard solution is prepared as it gives maximum permissible limit for comparison.
- H_2S and Na_2S solutions are the reactants and require acidic/ alkaline media for their reactions respectively.
- Acidic medium is adjusted by ammonia or acetic acid while alkaline medium is adjusted by NaOH.
- IP 66 does not have limit test for heavy metals.

Procedure

Method 'A'

Limit test for heavy metal IP 85

Test solution	*Standard solution*
i. As per monograph 25 ml solution prepared. ii. Add dilute acetic acid/ ammonia to adjust the pH between 3 and 4. iii. Add water up to 35 ml. iv. Add 10 ml of H_2S solution. v. Dilute it up to 50 ml with water.	i. Take 2 ml standard lead solution and dilute it up to 25 ml. ii. Add dilute acetic acid/ ammonia to adjust the pH between 3 and 4. iii. Add water up to 35 ml. iv. Add 10 ml of H_2S solution. v. Dilute it up to 50 ml with water.

Stir well and keep aside for 5 minutes. Observe and compare the brown colour produced.

Remarks

If brown colour obtained in test solution is less than standard solution, sample passes the limit test for heavy metal IP 85.

17 Describe the limit test for arsenic. (S.22, 23, W.22)

☞ Principle/Concept:

Arsenic impurity is converted into arsine gas which further reacts with mercuric chloride paper to form yellow stain of mercuric arsenide.

Reactions

i. Arsenic is converted into arsenic acid.

$$As \longrightarrow H_3AsO_4$$

ii. Arsenic acid is converted into arsenous acid.

$$H_3AsO_4 \longrightarrow H_3AsO_3$$

iii. Arsenous acid is converted into arsine gas.

$$H_3AsO_3 + 6[H] \longrightarrow AsH_3 \uparrow + 3H_2O$$

(Arsine gas)

iv. Arsine gas is converted into mercuric arsenide.

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

Note

- Purified water is used for dilution purpose and it is free from dissolved gases and impurities.
- Standard solution is prepared as it gives maximum permissible limit for comparison.
- Lead acetate cotton plug is used to avoid the interaction of hydrogen sulphide gas with mercuric chloride.
- Stannated zinc is used for slow and steady evolution of nascent hydrogen.
- Time required for the preparation is more therefore, this test should be observed after 40 minutes.
- All reagents should be having AST grade (free from arsenic).

Procedure

Limit test for sulphate IP 85

Test	*Standard*
i. Substance as per monograph.	i. 0.2 to 1 ml standard arsenic solution.
ii. Add 1 g of KI.	ii. Add 1 g of KI.
iii. Add 10 g of stannated zinc	iii. Add 10 g of stannated zinc

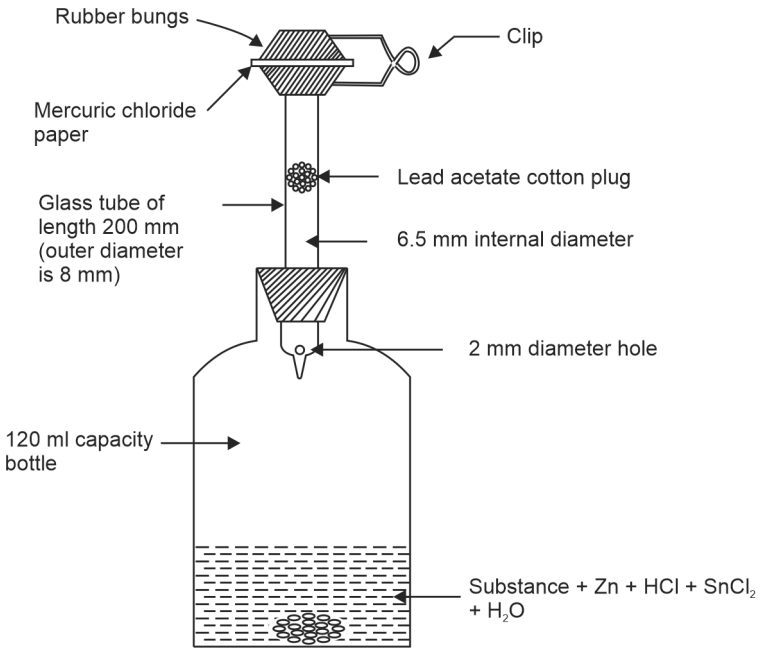
Shake the bottles and keep aside for 40 minutes.

Remarks

If yellow stain obtained in test mercuric chloride paper is less than standard stain, sample passes limit test for arsenic IP 85.

18 Describe apparatus used for limit test for arsenic. Explain Gutzeit test apparatus. (S.22, 23, 24, W.22)

☞ Gutzeit Test Apparatus



Construction

- It consists of a wide-mouthed glass bottle of capacity 120 ml.
- Glass tube of 200 mm length is passed in it through the rubber bungs.
- Glass tube is constricted at lower end.
- It has a 2 mm hole.
- The end of the tube should be above the liquid.
- Mercuric chloride paper is sandwitched between two rubber bungs and fixed by clip.
- Lead acetate cotton plug is inserted into the glass tube before operation.

19 What do you mean by "Test for Purity"? Explain various 'Tests for purity' as per pharmacopoeia.

☞ **Tests for Purity:**

These are the tests used to detect the undesirable impurities in the substance.

☞ **Following are the Tests for Purity:**

1. **Colour and odour:**

   These tests are used only when other tests for purity are not applicable. These tests are valuable to know whether the substance is reasonably aesthetic and hygienic or not.

2. **Physical constants:**

   Melting point, boiling point, refractive index, optical rotation are suitable physical constants. In the presence of impurities variations are observed in these constants.

3. **Humidity:**

   The amount of moisture in the atmosphere is called as humidity. Moisture content of medicinal substances is determined.

4. **Insoluble constituents:**

   It helps to detect the impurities in the substances.

5. **Organic impurities:**

   Organic impurities may be from raw material or intermediate products or by products in the reaction.

6. **Acidity or alkalinity:**

   Excess of acidity or alkalinity has an effect and keeping qualities of the compounds.

   So, some important tests are used to determine the purity of medicinal substances.

7. **Anions:**

   Acids like H_2SO_4 and HCl are widely used in the manufacture of medicinal substances. Therefore, chloride and sulphate are commonly present as impurity in many of the medicinal substances.

   Hence, tests for anions like Cl^-, SO_4^- are prescribed in official books.

8. **Cations:**

   Tests for cations include the tests for sodium, potassium, ammonium radical and heavy metals like iron, lead, copper, etc.

9. **Ash:**
   - The reside left after complete ignition (incineration) of the drug is called as ash.
   - Determination of ash value is performed to have the idea about the contents of foreign cations and heavy metals.
   - In organic compounds, the alkali salts are generally present as impurities. In such cases the determination of ash value is preferable.
   - Ash value is useful to judge the identity or purity of crude drugs.
   - Ash value helps in detecting the adulteration and substitutions in crude drugs.

10. **Arsenic/Lead:**

    Arsenic and lead both impurities are toxic in nature. So, their presence in medicinal compound is controlled by performing the limit test for arsenic and lead.

11. **Loss on drying (LOD):**
    - In this test, absorbed water or water of hydration is determined by drying under specified conditions.
    - Loss in weight due to drying also represents the residual volatile constituents including organic solvents as well as water.

12. **Loss on ignition (LOI):**

    This type of test is applied to stable substances, which are liable to contain thermolabile impurities.

    For example, contamination of light magnesium oxide by carbonate is controlled by performing this test.

    This test is applied to two classes of substances:

    (a) Those which are completely volatile when ignited

    (b) Those which undergo a major decomposition, leaving a residue of definite composition.

20 Give the difference between: "Determinant and Indeterminant errors".

☞

Determinant Errors (systematic errors)	Indeterminant Errors (random errors)
1. These are also know as systematic/non-random/constant errors.	1. These are also/known as non-systematic/random/accidental errors.
2. These errors are determinable and can be eliminated.	2. These errors can never be determined and eliminated but can be minimized by careful work.
3. These errors are recognized by the lack of agreement between the mean of a series of replicate determinations and the correct value.	3. These errors are recognized by variability in the replicate determinations, i.e. by the scatter of result about their mean.
4. These errors are quantified by measure of accuracy such as absolute error or the relative error of the mean.	4. These errors are quantified by a measure of precision such as standard deviation or the relative standard deviation.
5. The sources of these errors may be personal, instrumental, methodological, etc.	5. The sources of these errors may be personal, instrumental, etc.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. In limit test for iron I.P iron impurity react with **thioglycolic acid.**
2. Barium Sulphate Reagent (BSR) is used in **limit test for sulphate I.P.**
3. In limit test for arsenic **Arsine** is converted to arsenous acid/arsine gas.
4. Gutzeit apparatus is used for the **limit test for Arsenic**.
5. Cool storage condition means temperature range between **8°C and 25°C.**
6. The difference between measured value and true value is called as **error**.

7. The residue left after complete agitation of the drug is called as **ash**.
8. Arsine gas is carried and comes in contact with mercuric **chloride** in produces a yellow or brown stain.
9. The lead acetate cotton plug in limit test of arsenic is used to **trap the sulphides**.
10. Silver Nitrate is used in the **limit test of chloride**.
11. Limit test is a quantitative test designed to identify **impurity**.
12. **Buffer system** resists changes in pH of solution.
13. The assay of compound is done to **identify purity**.
14. Silver nitrate reagent is used to **chloride impurity**.
15. Assay of sodium chloride is based on **precipitation titration**.