सत्यमेव जयते

GOVERNMENT OF MAHARASHTRA

RAJARAM COLLEGE

VIDYANAGAR, KOLHAPUR – 416 004 (MS)

B. Sc. Part-I, Semester-II

ANALYSIS OF FERTILIZERS

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Quality Education...

For Personality...

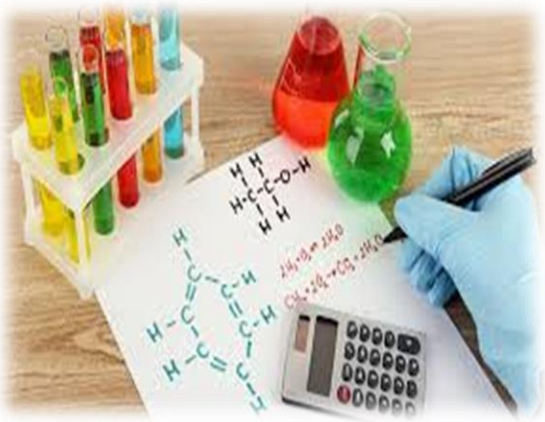
For Nationality...

ANALYTICAL CHEMISTRY ?

"Analytical Chemistry is the branch of chemistry which deals with the study of **separation**, **identification** and **determination** of constitutions of a sample of matter"

Analytical Chemistry is an interdisciplinary branch of science which deals with various branches of sciences.

"Science of Chemical Measurements.



ANALYTICAL CHEMISTRY

- What is chemical analysis?

- Questions to answer:
  - *Does the sample contain substance X?*
  - *How much of substance X is in the sample?*
  - *What is the identity of the substance in the sample?*

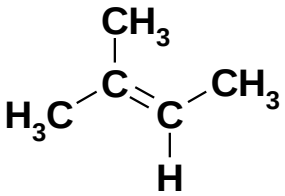
QUALITATIVE ANALYSIS

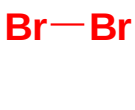
- *"An analysis in which we determine the identity of the constituent species in a sample"*
- Does it contain …?
- Type?
- Binding state?

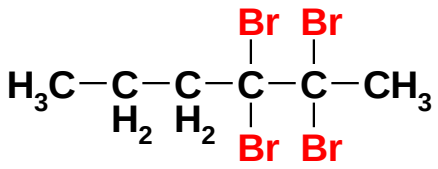
QUALITATIVE ANALYSIS

- Tests for the presence of >C=C< / -C≡C- using bromine solution.

>C=C< + Br_2 → rapid decolorization



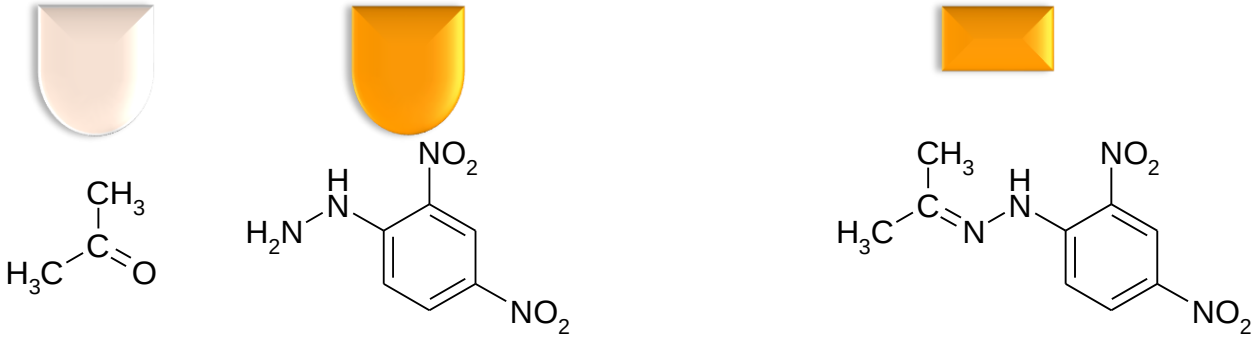




QUALITATIVE ANALYSIS

- Development of chemical tests to identify the presence of organic functional groups.

>C=O + DNPH → orange precipitate

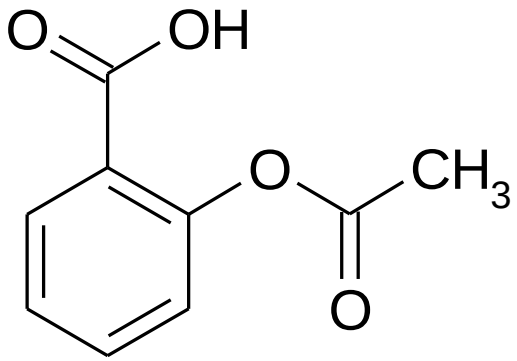


- Tests for the presence of carbonyl compounds using 2,4-dinitrophenylhydrazine (DNPH) solution

QUANTITATIVE ANALYSIS

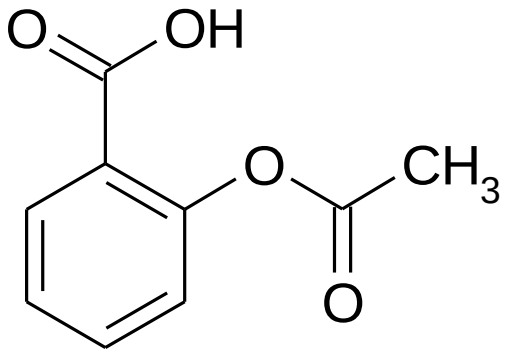
- *"An analysis in which we determine how much of a constituent species is present in a sample"*

- Developing methods to determine the concentration of targeted species in complex samples.

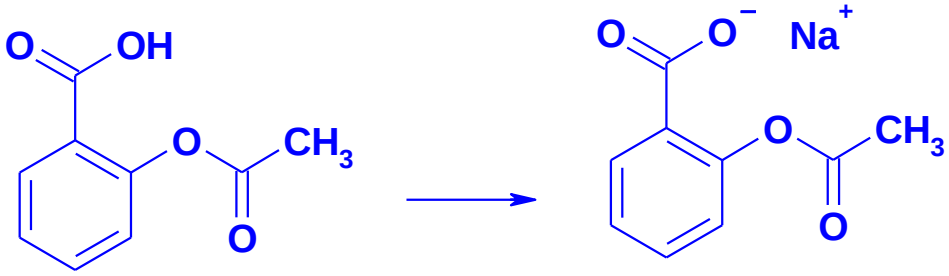


QUANTITATIVE ANALYSIS

e.g. measuring the amount of aspirin in analgesic tablets, by gravimetric method.



- *e.g.* measuring the amount of aspirin in analgesic tablets, by volumetric method.



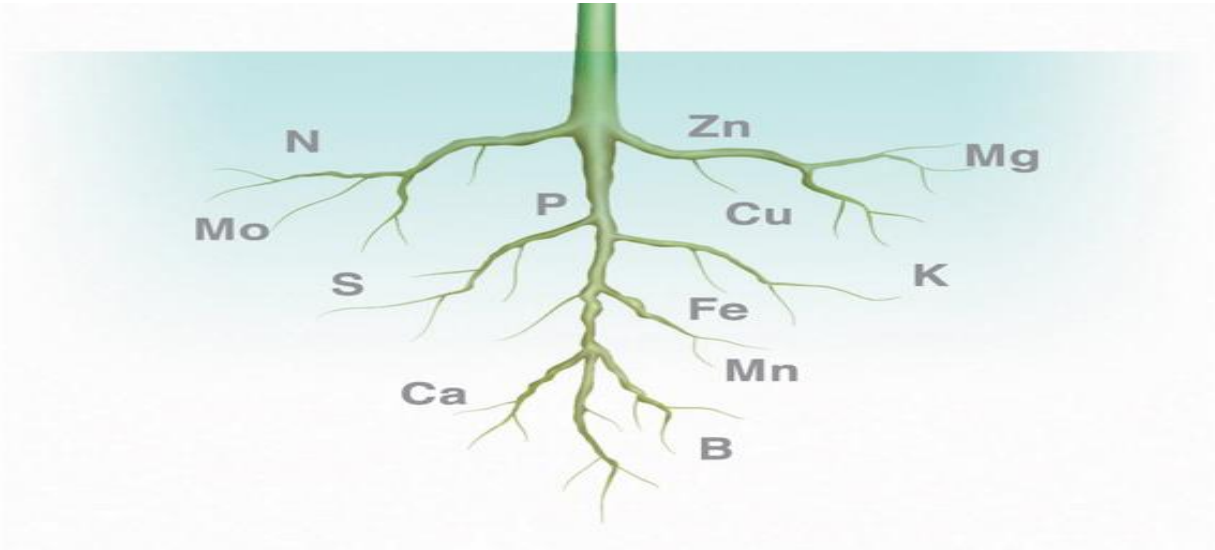
+ NaOH(aq) + H_2O

FERTILIZERS

"Organic or Inorganic materials of natural or synthetic origin added to the soil to supply one or more plant's nutrients"

NUTRIENTS

Macronutrients: "The nutrients which are required in large scale for healthy growth of plants."



Macro Elements
N - Nitrogen
P - Phosphorous
K - Potassium

Micro Elements
Fe - Iron
B - Boron
Zn - Zinc
Cu - Copper
Mn - Manganese
Mo - Molybdenum

Micronutrients: "The nutrients which are required in very small quantities for healthy growth of plants."

TYPES OF FERTILIZERS

A] On the basis of sources:

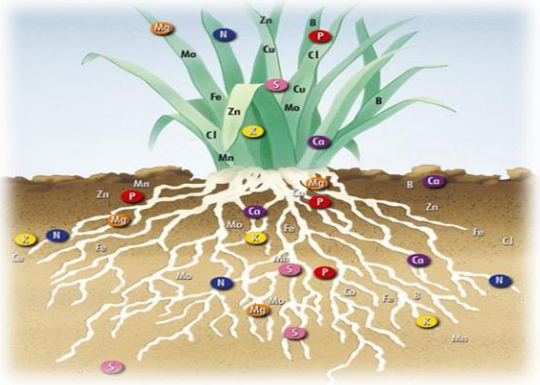
i) Naturals
ii) Synthetic or Artificial

B] On the basis of physical form:

i) Solid
ii) Liquid

C] On the basis of Chemical Compositions:

i) Nitrogenous
ii) Phosphatic
iii) Potassic



NEEDS OF FERTILIZERS

1. To grow healthy crops and produce better yields.
2. To recover the nutrients eaten by the crops.
3. To maintain pH (7 to 8) of the soil.
4. To supply good food and tonic to the plants.

NEEDS OF FERTILIZERS

Nitrogen (N)

is needed for vegetative growth and dark green color.

(easily leached out)

Nitrogen is the most important

nutrient.

Deficiency signs

reduced growth & yellowing of lower leaves.

Yellowing is called Chlorosis

NEEDS OF FERTILIZERS

Phosphorus (P)

important for seedling and young plant growth and develop good root system.

Deficiency signs

reduced growth, poor root systems, reduced flowering. Also thin stems and browning or purpling of foliage.

NEEDS OF FERTILIZERS

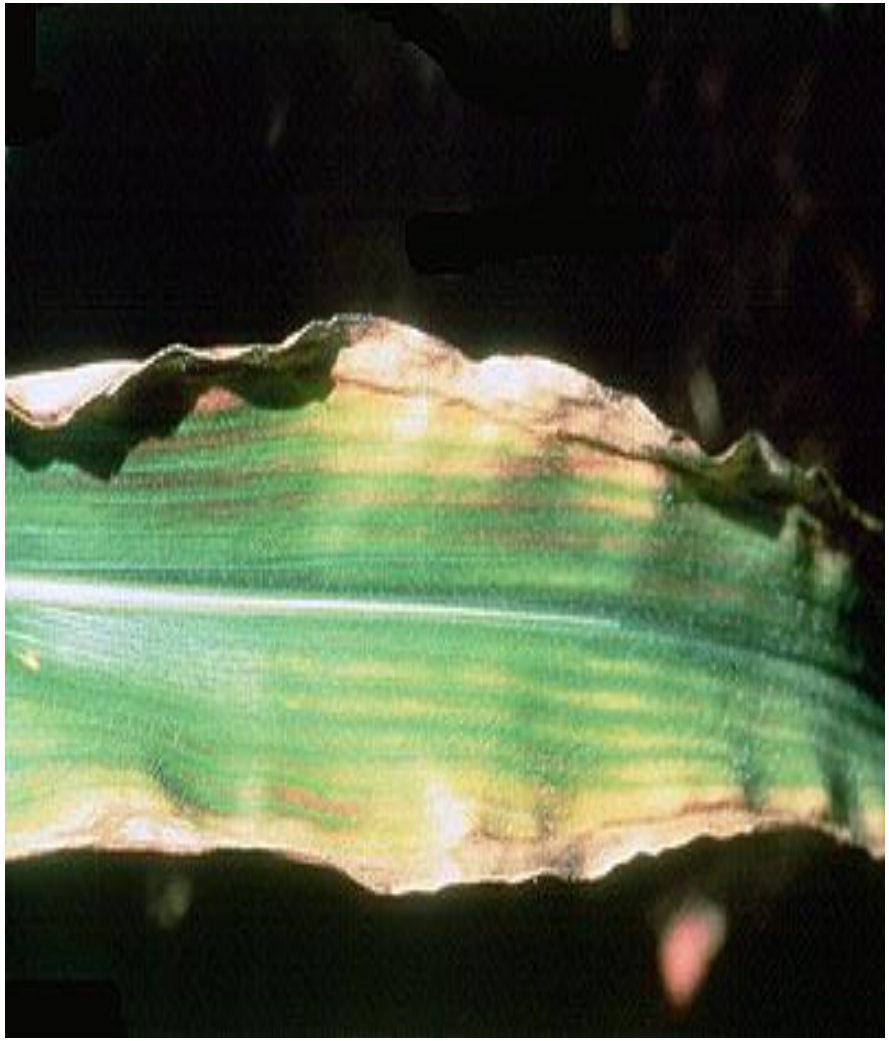
Potassium (K)

mined as a rock and made into a fertilizer – can be leached.

Deficiency signs

reduced growth, shortened internodes and some burn, scorched marks (brown leaves).

Too Much (K) – can cause nitrogen deficiency.



QUALITIES OF A FERTILIZERS

1. Easily available.
2. Affordable cost.
3. Easily water soluble.
4. Stable Chemical Composition.
5. Nutrients Present in it must be easily absorbable by the plants.
6. Maintain the pH of the soil (7 to 8).

N-P-K RATIO

1. Most commercial fertilizers have 3 numbers on the front label, separated by dashes.
   - For example: 5-10-5.

2. This is the fertilizer analysis or percentage by weight of the 3 major nutrients plants need:
   - Nitrogen, Phosphorus and Potassium, in that order.

3. These are abbreviated as N-P-K.

N-P-K RATIO

Reading a Fertilizer Label

N - 24 %
P - 5
K - 11 %
Remaining 60% is other nutrients and filler.

24-5-11

Nitrogen(N) Phosphorous (P) Potassium (K)

SAMPLING AND SAMPLE PREPARATION

"Sampling is the process of extracting a small portion of the material from its large quantity, which represent the composition of the whole material."

1. Sampling of Solid
2. Sampling of Liquid
3. Sampling of Gases

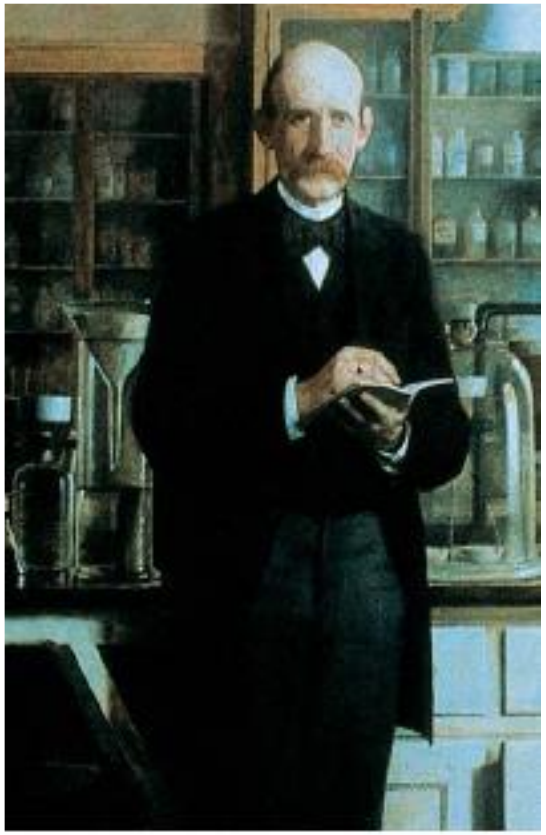
ESTIMATION OF NITROGEN

KJELDAHL'S METHOD

In 1883, Kjeldahl introduced analytical method for nitrogen determination.

Important in the analysis of food, fertilizers, protein etc.

Kjeldahl's method is faster method than Duma's method.



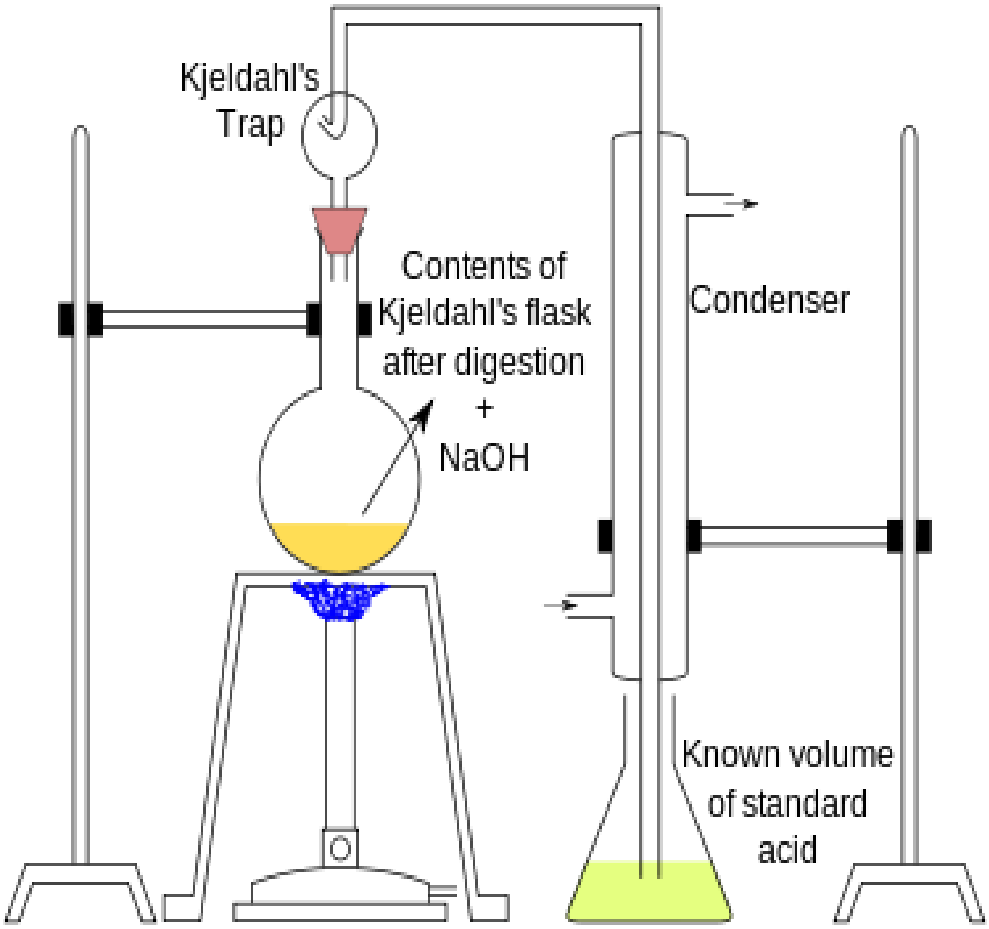
KJELDAHL'S METHOD

APPARATUS

1. Kjeldahl's flask
2. Condenser
3. Distillation flask
4. Burette
5. Pipette

CHEMICALS

1. NaOH
2. H_2SO_4
3. $CuSO_4$



KJELDAHL'S METHOD

DIGESTION

DISTILLATION

TITRATION

KJELDAHL'S METHOD

DIGESTION

$$\text{Organic N} + H_2SO_4 \xrightarrow[(Na_2SO_4)]{(Se\text{-}CuSO_4)} (NH_4)_2SO_4 + H_2O + CO_2$$

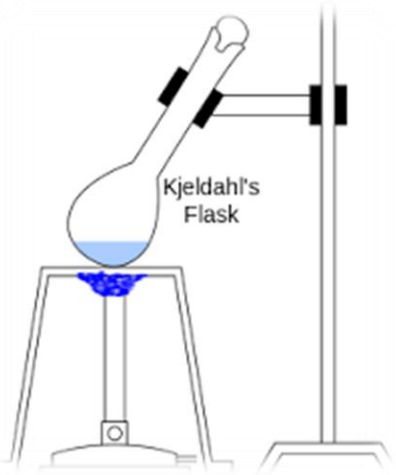
FROM FERTILIZER

AMMONIUM SULPHATE

H_2SO_4 – Oxidizing agent used to oxidize organic N to $(NH_4)_2SO_4$.

Na_2SO_4 – salt used to rise the temperature of the digestion.

$Se\text{-}CuSO_4$ - catalyst used to speed up the oxidation rate.



KJELDAHL'S METHOD

DIGESTION PROCEDURE

1. Weigh 10 g Fertilizer into 500 ml Kjeldahl's flask.
2. Add 10 ml distilled water and leave to stand for 10 mins.
3. Add the catalyst.
4. Add 2 tablets Na_2SO_4.
5. Add 20 ml Conc. H_2SO_4.
6. Digest until clear and colourless (1 – 1½ hrs).
7. Further digest for 30-45 mins.
8. Allow the flask to cool.

KJELDAHL'S METHOD

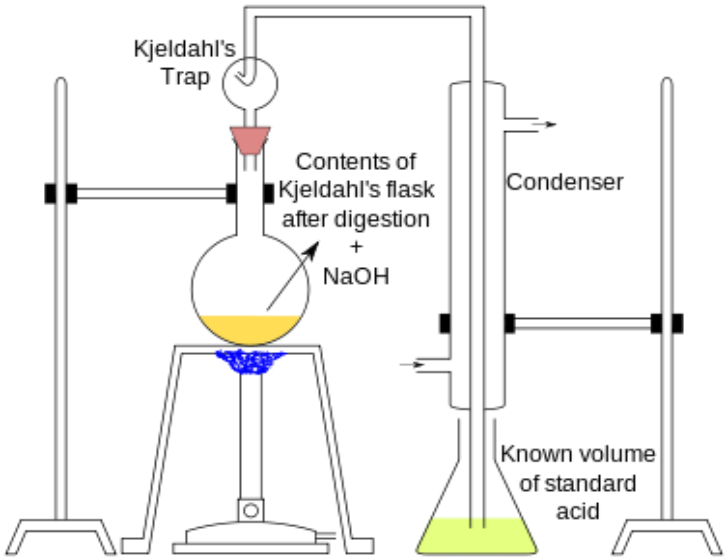
DISTILLATION

i) Free NH_4 is liberated from the solution by steam distillation in the presence of excess NaOH:

$$(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3\uparrow + Na_2SO_4 + 2H_2O$$

ii) The NH_3 evolved is collected in excess H_2SO_4 to form ammonium sulphate.

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$



KJELDAHL'S METHOD

DISTILLATION PROCEDURE

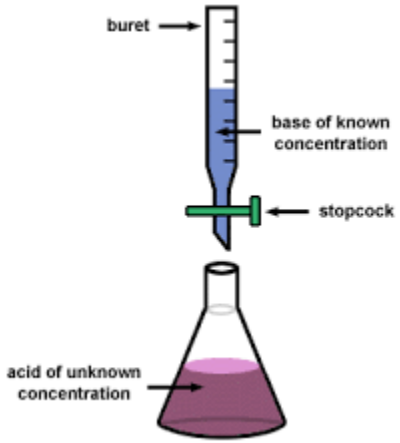
1. Transfer an aliquot of 10 ml of the liquid into the Kjeldahl's apparatus.
2. Add 15 ml of the strong NaOH.
3. Distil over steam for 10 minutes into 10 ml of the Sulphuric acid in a 500 ml conical flask.

KJELDAHL'S METHOD

TITRATION

The amount of NH_3 liberated and captured by sulphuric acid is determined by titrating with 0.1N NaOH

$$H_2SO_4 + 2NaOH \longrightarrow (Na)_2SO_4 + 2H_2O$$



KJELDAHL'S METHOD

CALCULATION

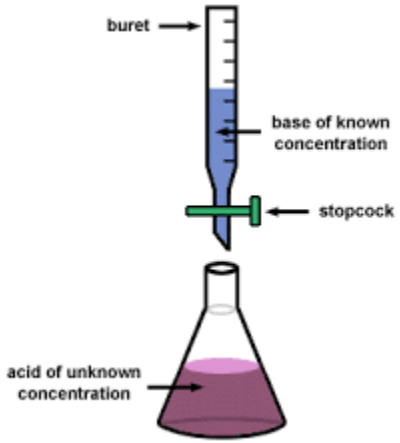
W gm of sample = V X N X 14 X 10^{-3} Kg of N_2

Where V = Volume of H_2SO_4 consumed.

N = Normality of H_2SO_4

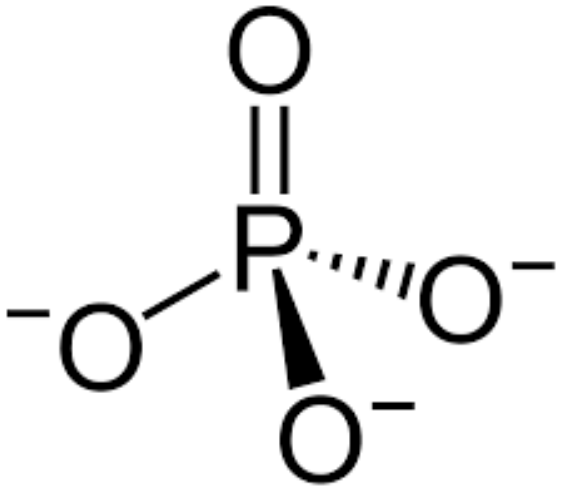
W = Weight of sample

$$100 \text{ kg of sample} = \frac{100 \times V \times N \times 14 \times 10^{-3}}{W} \text{ Kg of } N_2$$

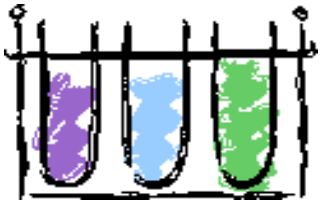


ESTIMATION OF PHOSPHORUS

AMMONIUM MOLYBDUM PHOSPHATE METHOD

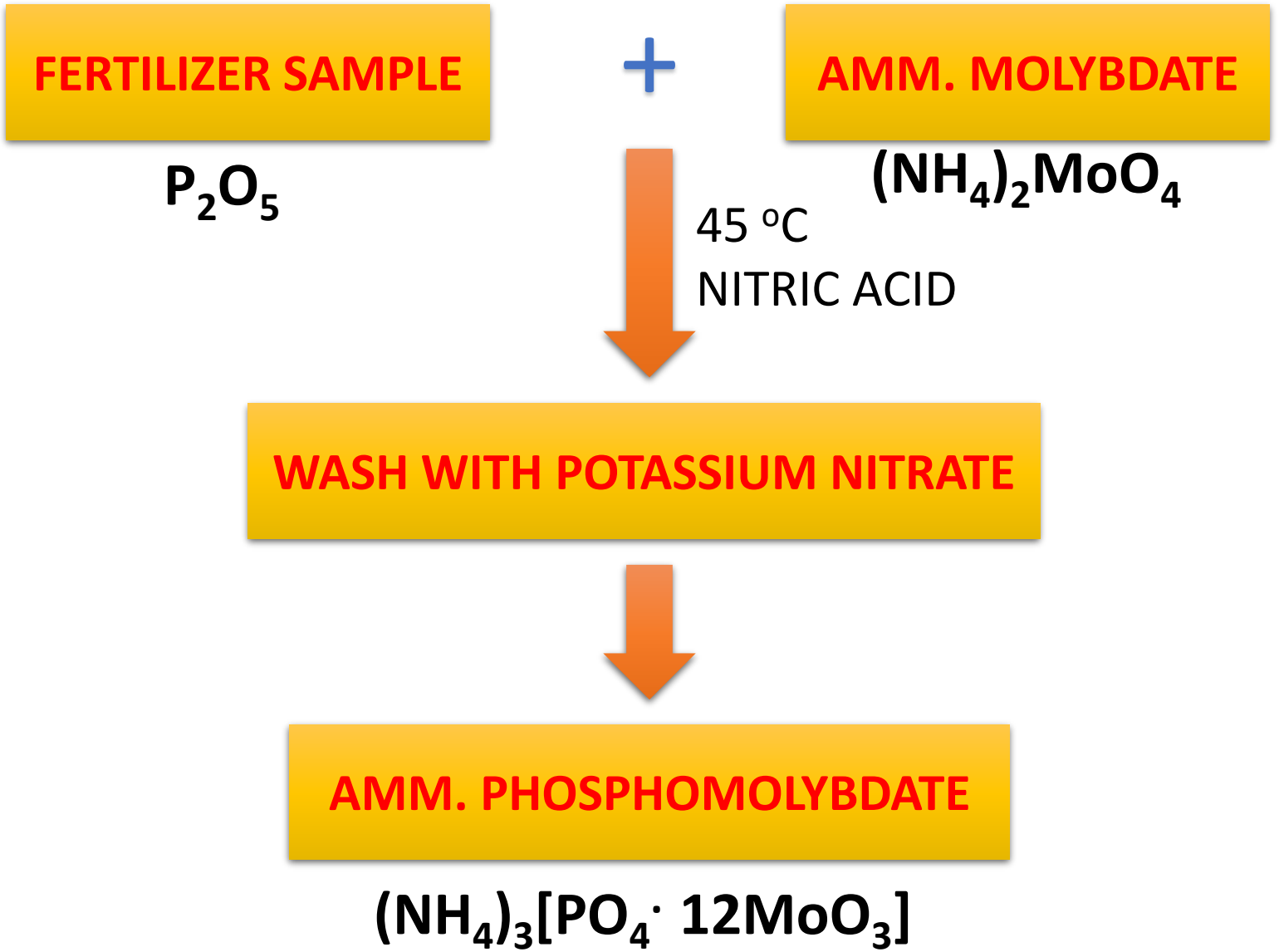


ORTHOPHOSPHATE



ESTIMATION OF PHOSPHORUS

AMMONIUM MOLYBDUM PHOSPHATE METHOD



ESTIMATION OF PHOSPHORUS

AMMONIUM MOLYBDUM PHOSPHATE METHOD

TITRATION

AMM. PHOSPHOMOLYBDATE

1 N NaOH

1 ml 1N NaOH = 0.001349 gm of P = 0.003088 gm of P_2O_5

X ml 1N NaOH = ‘A’ gm of P or ‘B’ gm of P_2O_5

ESTIMATION OF PHOSPHORUS

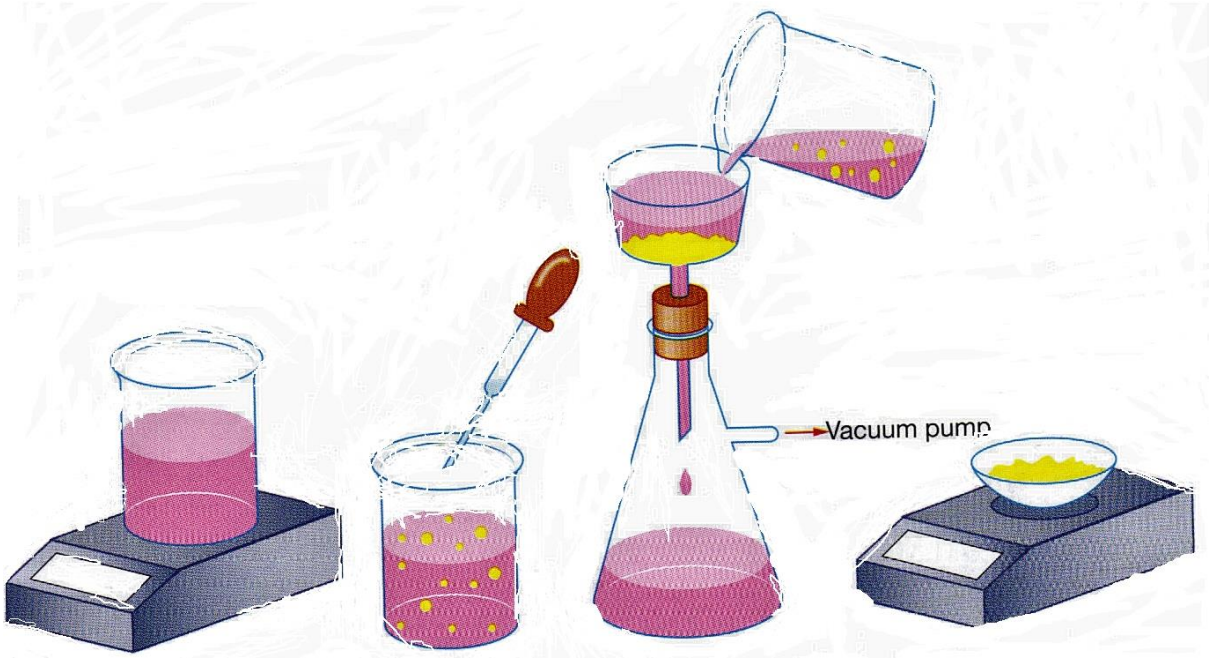
AMMONIUM MOLYBDUM PHOSPHATE METHOD

GRAVIMETRIC METHOD

"Gravimetric analysis

is type of quantitative analysis

by weighing"



GRAVIMETRIC ANALYSIS

SOME IMPORTANT TERMS:

PRECIPITATION: It is a process of forming a precipitate due to chemical reaction.

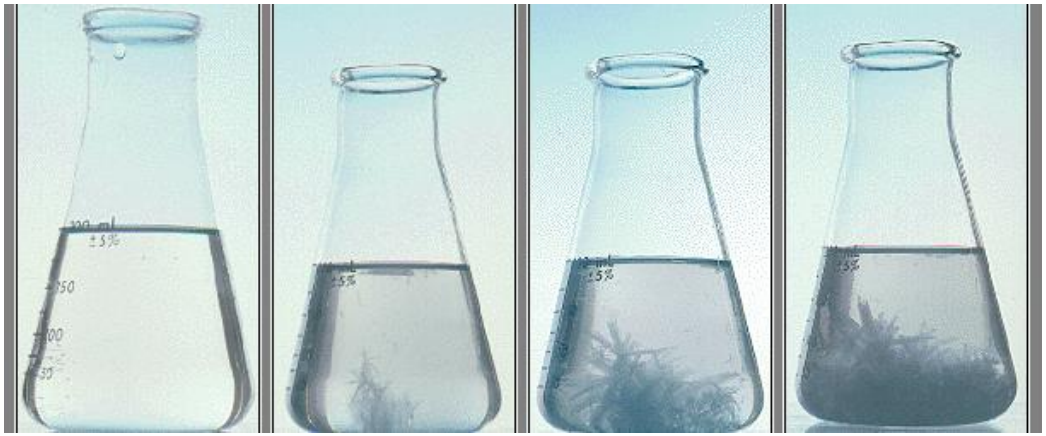
OR

It is a reaction in which positive ions of one substance combine with negative ion of other substance in solution to form sparingly soluble substance.

Determination of calcium in natural water:

Procedure: **A**dd an excess of oxalic acid ($H_2C_2O_4$) to a measured the volume of sample.

$$Ca^{2+}(aq) + C_2O_4^{2-}(aq) \rightarrow CaC_2O_4(s)$$



GRAVIMETRIC ANALYSIS

SOME IMPORTANT TERMS:

PRECIPITATE: It is an insoluble solid separated from the mother liquor due to chemical reaction.

PRECIPITANT: It is a Chemical reagent that form precipitate on addition to solution.

Determination of calcium in natural water:

Procedure: **A**dd an excess of oxalic acid ($H_2C_2O_4$) to a measured the volume of sample.

PRECIPITANT

$$Ca^{2+}(aq) + C_2O_4^{2-}(aq) \rightarrow CaC_2O_4(s)$$

PRECIPITATE

ESTIMATION OF PHOSPHORUS

AMMONIUM MOLYBDUM PHOSPHATE METHOD

GRAVIMETRIC METHOD

AMM. PHOSPHOMOLYBDATE

↓

6N AMMONIA SOLUTION

↓

AMMONIUM ACETATE

↓

OXINE SOLUTION

↓

ACETIC ACID

↓

DRY THE PPT AT 130 -140 ^{0}C

ESTIMATION OF PHOSPHORUS

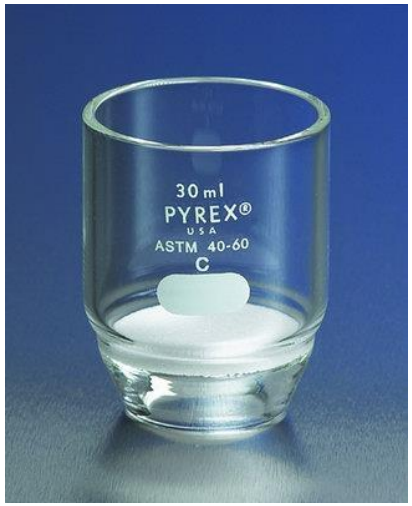
AMMONIUM MOLYBDUM PHOSPHATE METHOD

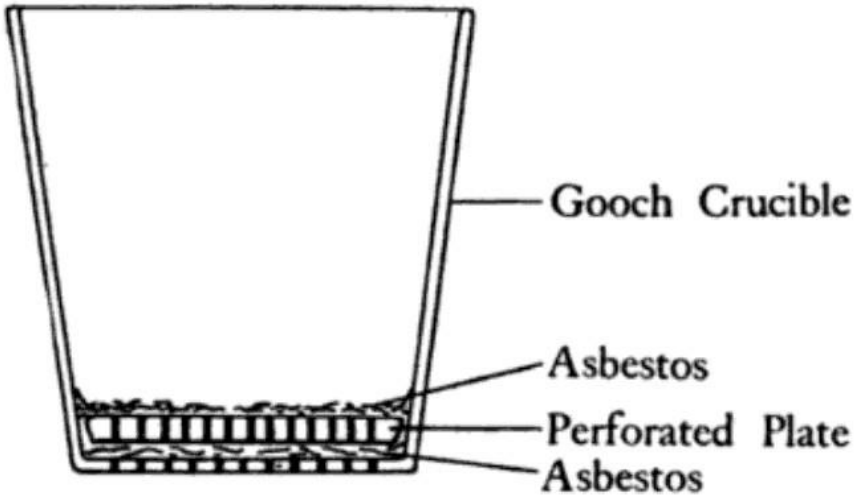
GRAVIMETRIC METHOD

$MoO_2(C_9H_6ON)_2$

MOLYBDYL OXINATE

$P = 0.006202 \times \text{WEIGHT OF } MoO_2(C_9H_6ON)_2$

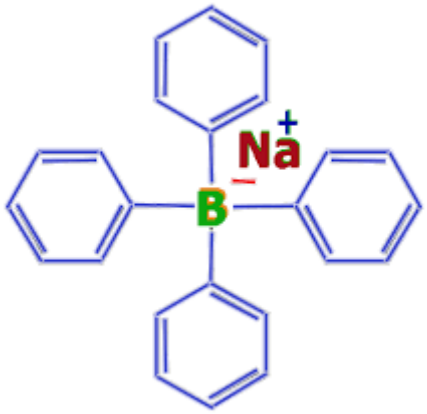




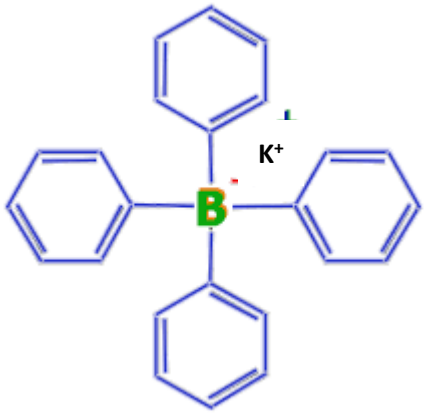
ESTIMATION OF POTASSIUM

SODIUM TETRAPHENYL BORATE METHOD

K FROM FERTILIZER **+**



SODIUM TETRAPHENYL BORATE



POTASSIUM TETRAPHENYL BORATE

TITRATION

IN BURETTE: MERCURIC NITRATE SOLUTION

INDICATOR: FERRIC NITRATE + SODIUM THIOCYANATE

END POINT: DECOLORISATION OF FERRIC SODIUM THIOCYANATE

1. The elements required for healthy growth of plants are known as…..

A. Nutrients

B. Elements

C. Nutrition

D. None of these

2. Fertilizers are essentially required to maintain the pH of the soil….

A. 1 to 3

B. 7 to 8

C. 4 to 5

D. 1 to 6

3. ……. Method used for the analysis of N from Fertilizers.

A. Kjeldahl's

B. Total Kjeldahl's

C. Both A and B

D. None of these

4. Nutrients in which elements required for healthy growth of plants are present on large scale are known as ……..

A. Micronutrients

B. Macronutrient

C. Total nutrients

D. Mixed nutrients

5. STPB method is used for the analysis of

A. N

B. K

C. Both A and B

D. P

Thank You...