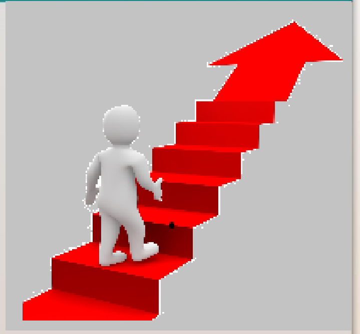
Objectives



At the end of this unit , the student is expected to be able to :

1- Understand the fundamentals of gravimetric analysis .
2- Follow the steps of the gravimetric analysis.
3- Choose the appropriate precipitating agent for a certain analyte .
4- Avoid or at least minimize the contamination of the precipitate .
5- Optimize the precipitation conditions in order to obtain a desirable precipitate .
6- Do all sorts of calculations related to gravimetric analysis .

Introduction

Gravimetric methods are quantitative methods that are based on measuring the mass of a pure compound to which the analyte is chemically related. Since weight can be measured with greater accuracy than almost any other fundamental property, gravimetric analysis is potentially one of the most accurate classes of analytical methods . However it is lengthy and tedious as a result, only a very few gravimetric methods are currently used . There are three fundamental types of gravimetric analysis . In **precipitation gravimetry**, which is our subject in this unit , the analyte is separated from a solution of the sample as a precipitate and is converted to a compound of known composition that can be weighed . In **volatilization gravimetry**, the analyte is separated from other constituents of a sample by conversion to a gas . The weight of this gas then serves as a measure of the analyte concentration . In **electrogravimetry**, the analyte is separated by deposition on an electrode by an electrical current. The mass of this product then provides a measure of the analyte concentration.

What Is Gravimetric Analysis

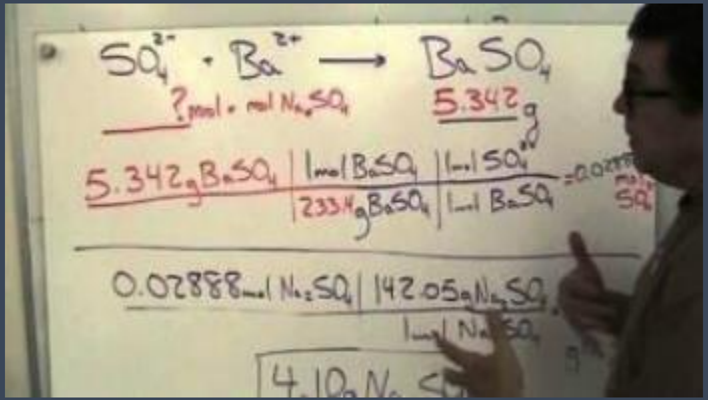
In precipitation gravimetry, the analyte is converted to a sparingly soluble precipitate. This precipitate is then filtered, washed free of impurities, converted to a product of known composition by suitable heat treatment, and weighed. For example, a precipitation method for determining calcium in natural waters involves the addition of $C_2O_4^{2-}$ as a precipitating agent :

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

The precipitate CaC_2O_4 is filtered, then dried and ignited to convert it entirely to calcium oxide:

$$CaC_2O_4\,(s) \rightarrow CaO\,(s) + CO\,(g) + CO_2(g)$$

After cooling, the precipitate is weighed, and the calcium content of the sample is then computed.



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Steps In Gravimetric Analysis

The steps required in gravimetric analysis, after the sample has been dissolved, can be summarized as follows: preparation of the solution , precipitation , digestion, filtration , washing , drying or igniting , weighing and finally calculation .

1. **Preparation of the Solution:** This may involve several steps including adjustment of the pH of the solution in order for the precipitate to occur quantitatively and get a precipitate of desired properties, removing interferences …etc.
2. **Precipitation:** This requires addition of a precipitating agent solution to the sample solution. Upon addition of the first drops of the precipitating agent, supersaturation occurs, then nucleation starts to occur where every few molecules of precipitate aggregate together forming a nucleus. At this point, addition of extra precipitating agent will either form new nuclei (precipitate with small particles) or will build up on existing nuclei to give a precipitate with large particles .
3. . This can be predicted by Von Weimarn ratio where, according to this relation the

Steps in a Gravimetric Analysis

particle size is inversely proportional to a quantity called the relative supersaturation where

Relative Supersaturation = (Q – S) / S

The Q is the concentration of reactants before precipitation at any point , S is the solubility of precipitate in the medium from which it is being precipitated. Therefore, in order to get particle growth instead of further nucleation (i.e granular precipitate and then low surface area) we need to make the relative supersaturation ratio as small as possible. In other words conditions need to be adjusted such that Q will be as low as possible and S will be relatively large. The optimum conditions for precipitation which make the supersaturation low are:

a. Precipitation using dilute solutions to decrease Q

b. Slow addition of precipitating agent to keep Q as low as possible

c. Stirring the solution during addition of precipitating agent to avoid concentration sites and keep Q low .

Steps in a Gravimetric Analysis

d. Increase solubility S by precipitation from hot solution .

e. Adjust the pH in order to increase S but not too much increase as we do not want to loose precipitate by dissolution .

f. Precipitation from Homogeneous Solution: In order to make Q minimum we can, in some situations, generate the precipitating agent in the precipitation medium rather than adding it. For example, in order to precipitate iron as the hydroxide, we dissolve urea in the sample. Heating of the solution generates hydroxide ions from the hydrolysis of urea. Hydroxide ions are generated at all points in solution and thus there are no sites of concentration. We can also adjust the rate of urea hydrolysis and thus control the hydroxide generation rate. This type of procedure can be very advantageous in case of colloidal precipitates.

Steps in a Gravimetric Analysis

3- Digestion of the Precipitate: The precipitate is left hot (below boiling) for 30 min to 1 hour in order for the particles to be digested. Digestion involves dissolution of small particles and reprecipitation on larger ones resulting in particle growth and better precipitate characteristics. This process is called Ostwald ripening. An important advantage of digestion is observed for colloidal precipitates where large amounts of adsorbed ions cover the huge area of the precipitate. Digestion forces the small colloidal particles to agglomerate which decreases their surface area and thus adsorption.

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Steps in a Gravimetric Analysis

The precipitate often contains ions that where trapped when the precipitate was formed. This is mostly a problem for crystalline precipitates. If the trapped ions are not volatile, then their presence will corrupt the weighing step. Concentration of interfering species may be reduced by digestion. Unfortunately , postprecipitation as we will see later will increase during digestion .

4-Washing and Filtering

Problems with surface adsorption may be reduced by careful washing of the precipitate. With some precipitates, peptization occurs during washing. Each particle of the precipitate has two layers , in primary layer certain ions are adsorbed and in the outer layer other ions of opposite charge are adsorbed . This situation makes the precipitate settle down . If the outer layer ions are removed then all the particles will have the same charge so the particles will be dissonant . This is called peptization .

Steps in a Gravimetric Analysis

This results in the loss of part of the precipitate because the colloidal form may pass through on filtration. , in case of colloidal precipitates we should not use water as a washing solution since peptization would occur. In such situations dilute volatile electrolyte such as nitric acid, ammonium nitrate, or dilute acetic acid may be used.

Usually, it is a good practice to check for the presence of precipitating agent in the filtrate of the final washing solution. The presence of precipitating agent means that extra washing is required. Filtration should be done in appropriate sized Goosh or ignition ashless filter paper. After the solution has been filtered, it should be tested to make sure that the analyte has been completely precipitated. This is easily done by adding a few drops of the precipitating reagent to the filtrate ; if a precipitate is observed, the precipitation is incomplete.

Steps in a Gravimetric Analysis

The common ion effect can be used to reduce the solubility of the precipitate. When Ag^+ is precipitated out by addition of Cl^-

$$Ag^+ + Cl^- \rightarrow AgCl\,(s)$$

The (low) solubility of AgCl is reduced still further by the excess of Ag^+ which is added, pushing the equilibrium to the right . It important to know that the excess of the precipitating agent should not exceed 50% of its equivalent amount , otherwise the precipitating agent may form a soluble complex with the precipitate :

$$AgCl + Cl^- \rightarrow AgCl_2^- \text{ (soluble complex)}$$

The following graph shows that most precipitates follow this pattern, but there are some anomalies such as Hg_2I and $BaSO_4$.

Steps in a Gravimetric Analysis

Example : To precipitate 10 moles of Ag^+ as Ag_2S , how many moles of the precipitating agent S^{2-} do you need to obtain complete precipitation ?

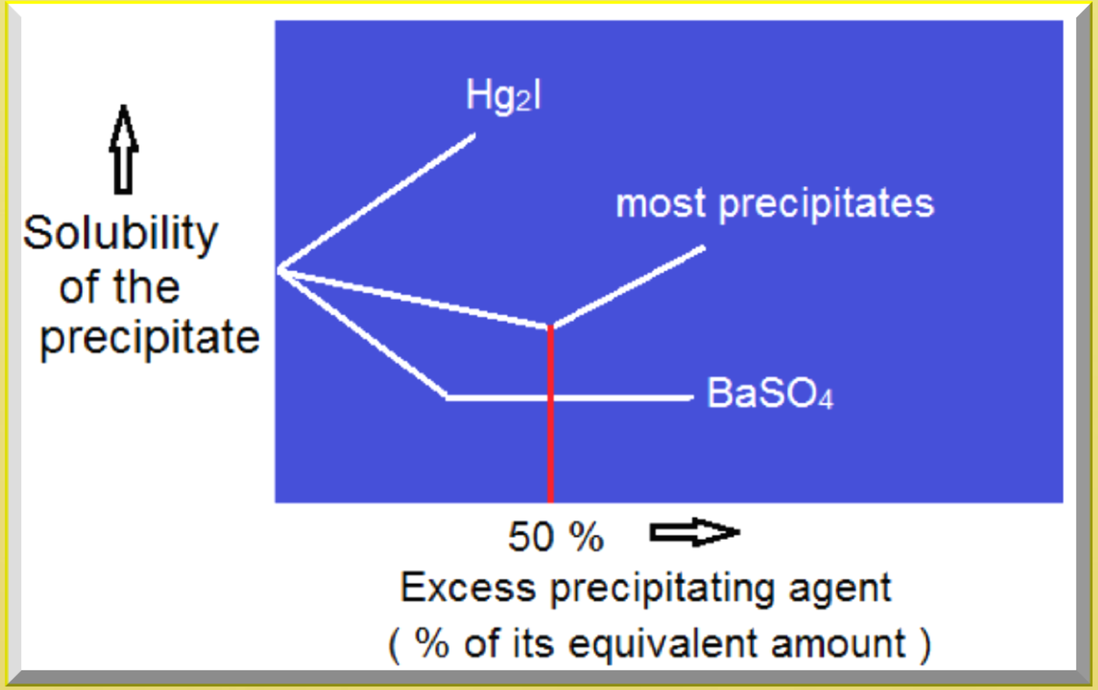
Solution : According to the following precipitation reaction :

$$2Ag^+ + S^{2-} \rightarrow Ag_2S$$

The equivalent amount of S^{2-} = 5 moles .

50% of the equivalent amount = 2.5 moles

So the total amount of S^{2-} needed for complete precipitation of Ag^+ = 5 + 2.5 = 7.5 moles



Steps in a Gravimetric Analysis

5- Drying and Ignition: The purpose of drying (heating at about 120-150 oC in an oven) is to remove the remaining moisture while the purpose of ignition in a muffle furnace at temperatures ranging from 600-1200 oC is to get a material with exactly known chemical structure so that the amount of analyte can be accurately determined . The precipitate is converted to a more chemically stable form. For instance, calcium ion might be precipitated using oxalate ion, to produce calcium oxalate (CaC_2O_4) which is hydrophil , therefore it is better to be heated to convert it into $CaCO_3$ or CaO . The $CaCO_3$ formula is preferred to reduce weighing errors as mentioned in previous lectures .

Steps in a Gravimetric Analysis

It is vital that the empirical formula of the weighed precipitate be known, and that the precipitate be pure; if two forms are present, the results will be inaccurate.

6-Weighing the precipitate : The precipitate can not be weighed with the necessary accuracy in place on the filter paper; nor can the precipitate be completely removed from the filter paper in order to weigh it.

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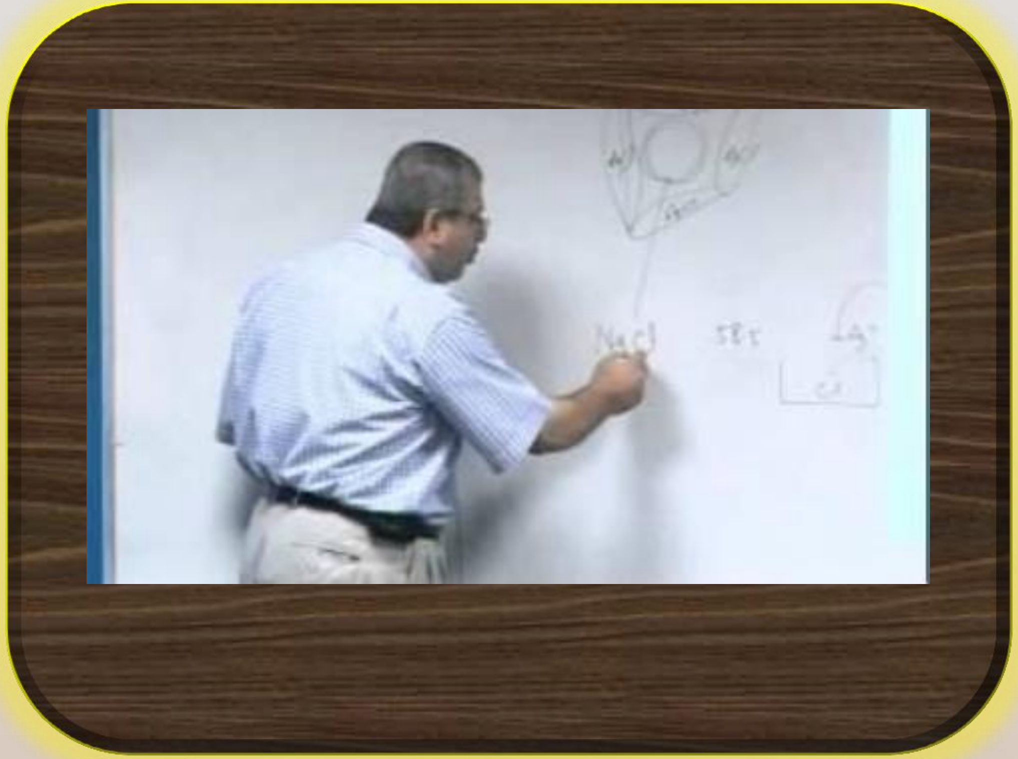
http://www.youtube.com/watch?v=1F-jRJK6PwU#t=4

Steps in a Gravimetric Analysis

The precipitate can be carefully heated in a crucible until the filter paper has burned away; this leaves only the precipitate. (As the name suggests, "ashless" paper is used so that the precipitate is not contaminated with ash.) . If you use Goosh crucible then after the precipitate is allowed to cool (preferably in a desicator to keep it from absorbing moisture), it is weighed (in the crucible).

Steps in a Gravimetric Analysis

The mass of the crucible is subtracted from the combined mass, giving the mass of the precipitated analyte. Since the composition of the precipitate is known, it is simple to calculate the mass of analyte in the original sample.



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VIDEO
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Impurities in Precipitates

Impurities in Precipitates No discussion of gravimetric analysis would be complete without some discussion of the impurities which may be present in the precipitates. There are two typs of impurities :

a. Coprecipitation

This is anything unwanted which precipitates with the analyte during precipitation . Coprecipitation occurs to some degree in every gravimetric analysis (especially barium sulfate and those involving hydrous oxides). You cannot avoid it all what you can do is minimize it by careful precipitation and thorough washing :

1- **Surface adsorption**

Here unwanted material is adsorbed onto the surface of the precipitate. Digestion of a precipitate reduces the amount of surface area and hence the area available for surface adsorption. Washing can also remove surface material.

Impurities in Precipitates

2- **Occlusion**

This is a type of coprecipitation in which impurities are trapped within the growing crystal. And can be reduced by digestion and reprecipitation .

b. **Postprecipitation**

Sometimes a precipitate standing in contact with the mother liquor becomes contaminated by the precipitation of an impurity on top of the desired precipitate .To reduce postprecipitation filter as soon as the precipitation is complete and avoid digestion .

Precipitating Agents

Precipitating Agents :

Ideally a gravimetric precipitating agent should react specifically or at least selectively with the analyte. Specific reagents which are rare, react only with a single chemical species. Selective reagents which are more common, react with a limited number of species. In addition to specificity and selectivity, the ideal precipitating reagent would react with analyte to give a precipitate that has the preferred requirements which have been previously discussed.

Inorganic precipitating agents :

The inorganic precipitants e.g. S^{2-} , CO_3^{2-} , PO_4^{3-} ...etc are usually not selective compared to the organic precipitants but it give precipitates with well known formula .

Precipitating Agents

Organic precipitating agents :

The organic precipitants such as dimethglyoxime and 8-hydroxyquinoline are more selective than inorganic precipitants . They produce with the analyte less soluble precipitate (small K_{sp}) . They also have high molecular weight so that the weighing error is redued . The disadvantage of organic precipitants is that they usually form with the analyte a precipitate of unknown formula , therefore the precipitate is burned to the metal oxide .

Calculations in Gravimetric Analysis

Calculation of Results from Gravimetric Data :

The results of a gravimetric analysis are generally computed from two experimental measurements : the weight of sample and the weight of a known composition precipitate .The precipitate we weigh is usually in a different form than the analyte whose weight we wish to find . The principles of converting the weight of one substance to that of another depend on using the stoichiometric mole relationships. We introduced the gravimetric factor(GF), which represents the weight of analyte per unit weight of precipitate. It is obtained from the ratio of the formula weight of the analyte to that of the precipitate, multiplied by the moles of analyte per mole of precipitate obtained from each mole of analyte, that is,

$$GF = \frac{mw\ of\ analyte\ (g/mole)}{mw\ of\ precipitate\ (g/mole)}\ X\ R = \frac{g\ analyte}{g\ precipitate}$$

Where R is the number of moles of analyte in one mole of precipitate

Calculations in Gravimetric Analysis

Example : Calculate GF for the conversions in the table on your right :

No.	Analyte	mw or aw	precipitate	mw
1	p	31	Ag_3po_4	419
2	K_2HPO_4	174	Ag_3PO_4	419
3	Bi_2S_3	514	$BaSO_4$	233.4
4	Al	27	Al_2S_3	150

Solution :

$$(1)\ GF = \frac{31}{419}\ X\ 1 = 0.074$$

$$(2)\ GF = \frac{174}{419}\ X\ 1 = 0.415$$

$$(3)\ GF = \frac{514}{233.4}\ X\ \frac{1}{3} = 0.734$$

$$(4)\ GF = \frac{27}{150}\ X\ 2 = 0.54$$

Calculations in Gravimetric Analysis

In gravimetric analysis, we are generally interested in the percent composition by weight of the analyte in the sample, that is,

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$$\%\ analyte = \frac{weight\ of\ \ analyte\,(g)}{weight\ of\ \ sample\,(g)}\ X\ 100$$

We obtain the weight of analyte from the weight of the precipitate and the corresponding weight/mole relationship

VIDEO
You Tube

Calculations in Gravimetric Analysis

$$Weight\ of\ \ analyte\ (g) = weight\ of\ \ precipitate\ \ (g)\ X\ \ GF$$

We can write a general formula for calculating the percentage composition of the analyte :

$$\%\ analyte = \frac{weight\ of\ \ precipitate\ (g)\ X\ \ GF\ (\ g\ \ analyte\ /\ g\ \ precipitate\ )}{weight\ of\ \ sample\ (g)}\ X\ 100$$

Calculations in Gravimetric Analysis

Example : A 0.5962 g sample of iron ore is dissolved in perchloric acid ($HClO_4$). All iron present is oxidized to Fe^{3+}. The solution is filtered to remove solid matrix materials and made basic with addition of ammonium hydroxide. The iron precipitates as the $Fe(OH)_3 \cdot xH_2O$ gel. The precipitate is collected in a cistern crucible and ignited to produce Fe_2O_3. What is the wt. % of iron in the sample if the analysis produced 0.3210 g Fe_2O_3?

Solution : The overall reaction is :

$$2\,Fe^{3+} + 3\,OH^- \rightarrow Fe_2O_3 + 3/2\,H_2$$

From this we derive the *gravimetric factor* relating weight of final material to the weight of iron analyte :

Calculations in Gravimetric Analysis

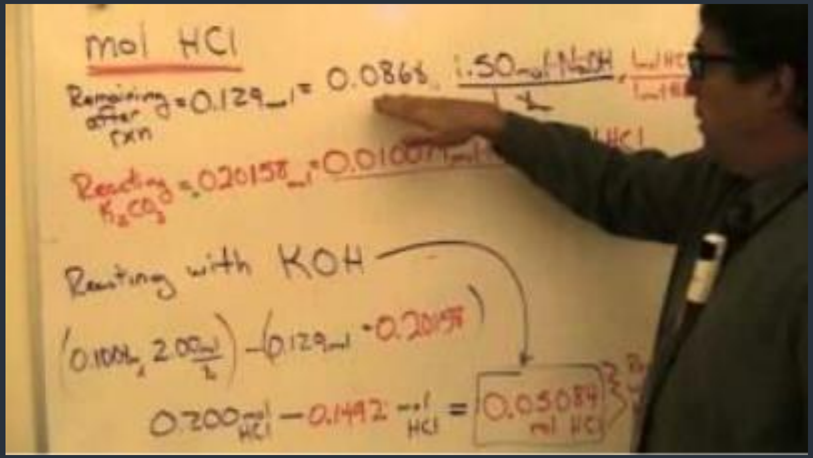
$$gravimetric\ \ factor = \frac{mw\ of\ \ analyte}{mw\ of\ \ ppt.}\ X\ \ no.\ of\ \ moles\ of\ \ analyte\ in\ one\ mole\ of\ \ ppt.$$

$$= \frac{55.85}{159.69}\ X\ \ 2 = 0.6995$$

$$Weight\ \ of\ \ \ iron = Weight\ of\ \ ppt.\ X\ \ gravimetric\ \ factor$$

$$= 0.3210\ \ X\ \ 0.6995\ \ = 0.2245\ g$$

$$\%\ iron\ \ \ in\ \ the\ \ ore = \frac{0.2245}{0.5962}\ X\ 100 = 37.66$$



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Calculations in Gravimetric Analysis

Example : A certain barium halide exists as the hydrated salt $BaX_2.2H_2O$. where X is the halogen. The barium content of the salt can be determined by gravimetric methods. A sample of the halide (0.2650 g) was dissolved in water (200 mL) and excess sulfuric acid added. The mixture was then heated and held at boiling for 45 minutes. The precipitate (barium sulfate , mw = 233.3) was filtered off, washed and dried. Mass of precipitate obtained = 0.2533 g. Determine the identity of X.

VIDEO
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Calculations in Gravimetric Analysis

Solution : The precipitate is barium sulfate . The first stage is to determine the number of moles of barium sulfate produced, this will, in turn give us the number of moles of barium in the original sample.

Number of moles of Ba = Wt. of $BaSO_4$ ppt. / mw of $BaSO_4$

$$= 0.2533 / 233.3 = 1.09 \times 10^{-3}$$

This is the number of moles of barium present in the precipitate and, therefore, the number of moles of barium in the original sample. Given the formula of the halide, (i.e. it contains one barium per formula unit), this must also be the number of moles of the halide. From this information we can deduce the relative molecular mass of the original halide salt :

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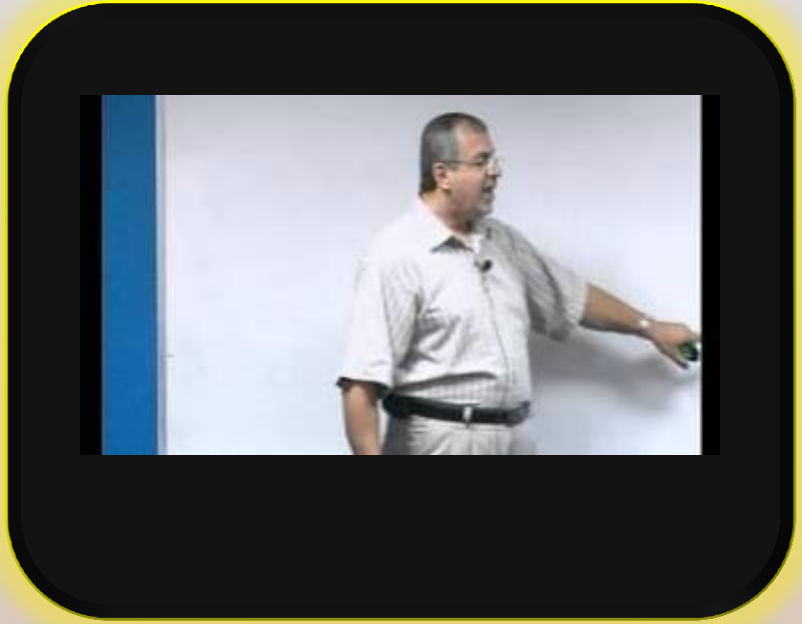

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Calculations in Gravimetric Analysis

mw of $BaCl_2 . 2H_2O$ = wt. of $BaCl_2.2H_2O$ / no. of moles of Ba in $BaCl_2.2H_2O$

$= 0.2650 / 1.09 X 10^{-3} = 244.18$

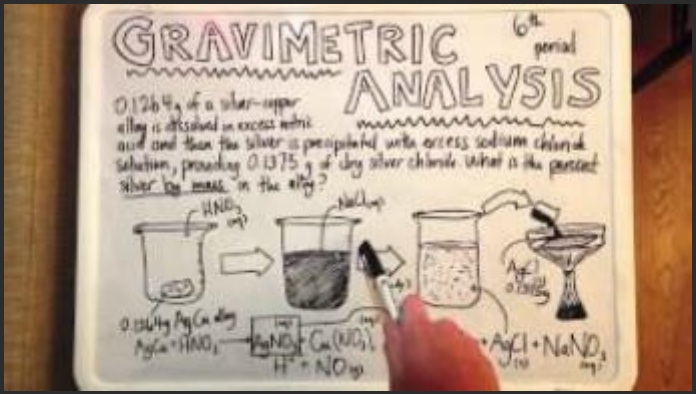
Atomic wt. of Ba + 2 X mw of H_2O = 137.327 + 2 X 18

= 173.327

aw of 2X = 244.18 – 173.327 = 70.85

aw of X = 70.85 / 2 = 34.43

The atomic weight (am) of chlorine is 35.45 which is in good agreement with the result obtained and hence the halide salt is hydrated barium chloride and X = Chlorine .



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Calculations in Gravimetric Analysis

Example : You have 10 mL of 0.1 M solution of S^{2-} and you want to precipitate S^{2-} as Ag_2S . Calculate the volume of 0.2 M solution of Ag^+ which must be added to achieve complete precipitation ?

Solution :

$2\,Ag^+ \quad + \quad S^{2-} \quad \leftrightarrow \quad Ag_2S$

mmoles S^{2-} = 10 X 0.1 = 1

mmoles Ag^+ (equivalent) = mmoles S^{2-} X 2/1 =1X 2/1= 2

mmoles Ag^+ required for complete precipitation = mmoles Ag^+ (equivalent) + 50% of 2 mmole
= 2 + 1 = 3

mmoles Ag^+ = M X Vol. (mL)

3 = 0.2 X Vol. (mL)

Vol. (mL) = 3 / 0.2 = 15 mL

Evaluation of Gravimetric Analysis

Gravimetric analysis, if methods are followed carefully, provides for exceedingly precise analysis. In fact, gravimetric analysis was used to determine the atomic masses of many elements to six figure accuracy. Gravimetry provides very little room for instrumental error and does not require a series of standards for calculation of an unknown. Also, methods often do not require expensive equipment. Gravimetric analysis, due to its high degree of accuracy, when performed correctly, can also be used to calibrate other instruments in place of reference standards . However , the long time needed for the analysis makes it tedious and time consuming for this reason , the volumetric analysis starts to overshadow gravimetry that is why we did not discuss gravimetry in more details . Gravimetric methods have been developed for most inorganic anions and cations, as well as for such neutral species as water, sulfurdioxide, carbon dioxide, and iudine. A variety of organic substances can also be easily determined gravimetrically.

Evaluation of Gravimwtric Analysis

Examples include lactose inmilk products, salkylates in drug preparations, phenolphthalein inlaxatives, nicotine in pesticides, cholesterol in cereals, and benzaldehyde in almond extracts.

Summary

In this unit we investigated the fundamentals of and the main steps in gravimetric analysis . We also discussed the optimal conditions that produce an easily filtered and pure precipitate . The precipitating agents have been briefly studied . The calculations of gravimetric analysis are investigated in details with help of solved examples and tutorial exercises . We tried to provide the student with some videos and graphs to help him understand the main aspects of gravimetric analysis .

Tutorial

Exercise 1 : A 0.4960 g sample of a $CaCO_3$ (mw = 100) is dissolved in an acidic solution. The calcium is precipitated as $CaC_2O_4 . H_2O$ (mw = 146) and the dry precipitate is found to weigh 0.6186 g. What is the percentage of CaO (mw = 56) in the sample?

Your answer :

Our answer next slide

Tutorial

Answer 1 :

Wt. CaO = Wt. of precipitate X (mw of CaO / mw of CaC_2O_4.HO) X 1

= 0.6186 X (56 / 146) X 1 = 0.237

% CaO = (wt. CaO / wt. sample) X 100 = (0.237 / 0.4960) X 100 = 47.78

Tutorial

Exercise 2 : 0.8 g sample contains sulfur S (aw = 32) has been dissolved . The sulfur is precipitated as $BaSO_4$ (mw = 233) . If the weight of the precipitate is 0.3 g calculate the percentage of sulfur in the sample ?

Your answer :

Our answer next slide

Tutorial

Answer 2 :

$$moles\ S = moles\ BaSO_4 = \frac{0.3\,(g)}{233\ (mw)} = 1.3\ X\ 10^{-3}$$

$$Wt.\ S = 1.3\,X\,10^{-3}\ X\,32 = 0.0412\ g$$

$$\%\ S = \frac{0.0412}{0.8}\ X\,100 = 5.2\ \%$$

Tutorial

Exercise 3 : 644 mg of a sample contains Mg (aw = 24) has been dissolved in water . The magnesium content of the sample is precipitated as $MgNH_4PO_4.6H_2O$ and ignited and weighed as $Mg_2P_2O_7$ (mw = 222) . If this weight is 290 mg , calculate the percentage of Mg in the sample ?

Your answer :

Our answer next slide

Tutorial

Answer 3 :

$$mmoles\ Mg = mmoles\ Mg_2P_2O_7\ X\ 2$$

$$= \frac{290}{222}\ X\ 2 = 2.61$$

$$Wt.\ Mg = 2.61\ X\ 24 = 62.64\ mg$$

$$\%\ Mg = \frac{62.64}{644}\ X\ 100 = 9.7\ \%$$

Tutorial

Exercise 4 : The silver content of 20 mL 0.1 M of Ag^+ solution is precipitated as Ag_2S using 0.05 M solution of S^{2-} according to the following complete reaction :

$$2\,Ag^+ + S^{2-} \rightarrow Ag_2S$$

Calculate the volume of S^{2-} solution that is required for complete precipitation of Ag^+ ?

Your answer :

Our answer next slide

Tutorial

Answer 4 : $2\ Ag^{+} + S^{2-} \leftrightarrow Ag_2S$

20 ml 0 .1M = 2 mmoles Ag^{+-} which is equivalent to 0ne mmole S^{2-}

For the precipitation to be complete we should add excess of the precipitating agent (S^{2-}) equal to 50% of its equivalent amount i.e.(0ne mole + 0.5 mole) of S^{2-} . That means the total amount of S^{2} which has to be added equal to 1.5 mole :

$$M = \frac{no.\ of\ \ mmoles}{V_{mL}}$$

$$0.O5 = \frac{1.5\ mmoles}{V_{mL}}$$

$$V_{mL} = \frac{1.5\ mmoles}{0.05} = 30\ \ mL$$

Tutorial

Exercise 5 : The aluminum (aw = 27) content of a 5 g sample is determined gravimetricaly by precipitating the aluminum as Al_2S_3 (mw = 150) . If the weight of the precipitate is 0.5 g , calculate the percentage of aluminum in the sample ?

Your answer :

Our answer next slide

GRAVIMETRIC ANALYSIS

Tutorial

Answer 5 :

$$\begin{array}{llll} \textit{One mole of } & Al_2S_3 & \textit{contains} & 2 \textit{ mole of } Al \\ & 150\ (mw) & \textit{contain} & 2\ x\ 27\ (aw) \\ \therefore & 0.5\ (g) & \textit{contains} & (Wt.\ of\ Al\ in\ the\ precipitate) \end{array}$$

$$Wt.\ of\ Al\ in\ the\ precipitate = \frac{0.5\ X\ 2\ X\ 27}{150} = 0.18\ (g)$$

$$\%_{w/w} Al = \frac{0.18(g)}{5(g)}\ X\ 100 = 3.6\ \%$$

Tutorial

Exercise 6 : Calculate the weight of Mn (aw = 55) in 2.5 g of Mn_3O_4 (mw = 229) ?

Your answer :

Our answer next slide

GRAVIMETRIC ANALYSIS

Tutorial

Answer 6 :

$$moles\ Mn = moles\ Mn_3O_4\ \ X\ 3$$

$$= \frac{2.5}{229}\ \ X\ 3\ \ = 0.0328$$

$$Wt.\ Mn\ \ = 0.0328\ \ X\ 55\ = 1.804\ \ g$$

GRAVIMETRIC ANALYSIS

Tutorial

Exercise 7 : For the determination of Zn (aw = 65) gravimetricaly in a sample it is precipitated and weighed as $Zn_2Fe(CN)_6$ (mw = 342) . (1) Calculate the weight of Zn in a sample which gives 0.35 g precipitate . (2) Calculate the weight of the precipitate which can be produced by a sample containing 0.5 g Zn ?

Your answer :

Our answer next slide

Tutorial

Answer 7 :

$$GF = \frac{65}{342} \; X \; 2 = 0.380$$

$$(1) \; Wt.\,of \;\; Zn = \;\; 0.380 \;\; X \;\; 0.35 = 0.133 \; g$$

$$(2) \;\; wt.\,of \;\; Zn \; = \; 0.5 = 0.380 \;\; X \;\; wt.\,of \;\; precipitat\,e$$

$$wt.\,of \;\; precipitate = 1.316 \; g$$

Tutorial

Exercise 8 : 0.4 g of an impure reagent of KCl (mw = 74.5) is dissolved and an excess of $AgNO_3$ solution is added . As a result of this 0.7332 g of AgCl (mw = 143.5) precipitate is formed . Calculate the percentage purity of KCl reagent ?

Your answer :

Our answer next slide

GRAVIMETRIC ANALYSIS

Tutorial

Answer 8 :

$$moles\ \ KCl = moles\ Cl^{-} = moles\ \ AgCl$$

$$= \frac{0.7332}{143.5} = 5.109\ X\ 10^{-3}$$

$$Wt.\ \ KCl\ \ = 5.109\ X\ 10^{-3}\ X\ 74.5 = 0.3807\ \ g$$

$$\%\ purity\ = \frac{0.3807}{0.4}\ X\ 100\ \ =\ \ 95.2\ \%$$

Tutorial

Exercise 9 : 0.1799 g of an organic compound is burned in O_2 atmosphere . The CO_2 produced is collected in $Ba(OH)_2$ solution where 0.5613 g of $BaCO_3$ (mw = 197) is precipitated . Calculate the percentage of carbon in the organic compound ?

Your answer :

Our answer next slide

Tutorial

Answer 9 :

$$\text{moles } C = \text{moles } BaCO_3$$

$$= \frac{0.5613}{197} = 2.85 \times 10^{-3}$$

$$\text{Wt. } C = 2.85 \times 10^{-3} \times 12 = 0.0342 \text{ g}$$

$$\% \, C = \frac{0.0342}{0.1799} \times 100 = 19.0 \%$$

Tutorial

Exercise 10 : Calculate the weight of AgI (mw = 235) that can be precipitated from 0.24 g of a sample of MgI_2 (mw = 258) which has a purity of 30.6 $\%_{w/w}$?

Your answer :

Our answer next slide

GRAVIMETRIC ANALYSIS

Tutorial

Answer 10 :

$$\begin{aligned} &each\ \ 100\ g\ \ sample\ \ contain\ \ 30.6\ g\ pure\ \ MgI_2 \\ &\quad 0.24\ g\ \ sample\ \ contain\ \ x\ \ g\ \ pure\ \ MgI_2 \end{aligned}$$

$$x\ \ g\ \ pure\ MgI_2 = 0.07344\ \ g$$

$$\begin{aligned} moles\ \ AgI &= moles\ \ MgI_2\ \ X\ 2 \\ &= \frac{0.07344}{258}\ \ X\ 2 = 5.7\ X\ 10^{-4} \end{aligned}$$

$$Wt.\ \ AgI = 5.7\ X\ 10^{-4}\ \ X\ 235 = 0.1338\ \ g$$

Tutorial

Exercise 11 : Calculate the molar concentration of 25 mL of a solution of $AgNO_3$ that required to completely precipitate SCN^- as AgSCN from 0.2124 g of KSCN (mw = 89) ?

Your answer :

Our answer next slide

Tutorial

Answer 11 :

$$\text{moles } AgNO_3 = \text{moles } KSCN = \frac{0.2124}{89} = 2.3865 \ X \ 10^{-3}$$

$$M_{AgNO_3} = \frac{\text{equivalent amount of } AgNO_3 + 50\% \text{ of eqivalent amount of } AgNO_3}{25 \ X \ 10^{-3} \ (L)}$$

$$M_{AgNO_3} = \frac{2.3865 \ X \ 10^{-3} + \frac{1}{2} X 2.3865 X 10^{-3}}{25 \ (mL) \ X \ 10^{-3} \ (L)} = 0.1432 \ M$$

GRAVIMETRIC ANALYSIS

Tutorial

Exercise 12 : 1.204 g of tablet containing saccharin $C_7H_7NO_3S$ is dissolved and the sulphur content is oxidized to SO_4^{2-} . Excess $Ba(NO_3)_2$ solution is added and the formed $BaSO_4$ precipitate weighed 0.5341 g .Calculate the percentage of saccharin in the tablets ?

Your answer :

Our answer next slide

GRAVIMETRIC ANALYSIS

Tutorial

Answer 12 : See this video

VIDEO
You Tube

VIDEO
Library

على الراغبين الاستماع الى محاضرات الاستاذ الدكتور/ ابراهيم زامل الزامل باللغة العربية عن هذا الموضوع الرجوع الى الروابط التالية :

التحليل الوزني

التحليل الوزني ٢

مصطلحات في الكيمياء التحليلية