Gravimetric Analysis Questions

Q-1: Which of the following crucibles is used when precipitates are dried in the muffle furnace in gravimetric analysis?
a) Crucible made of porcelain
b) Crucible made of silica
c) Both of the above
d) None of the above

Answer: c) Both of the above
Explanation: Crucible made of porcelain and silica are used when precipitates are dried in the muffle furnace in gravimetric analysis.

Q-2: Which of the following gravimetric analysis uses temperature as a function to measure a material's physical and chemical properties?
a) Electrogravimetry
b) Thermogravimetry
c) Volatilisation gravimetry
d) Precipitation gravimetry

Answer: b) Thermogravimetry is a thermal analysis method that measures changes in physical and chemical properties of materials as a function of increasing temperature or time.

Q-3: What is the principle of gravimetric analysis?
Answer: The gravimetric analysis principle is based on determining the mass % of an ion in a known amount of impure compound. It is then used to determine the mass % of the same ion in a known amount of impure substance.

Q-4: What are the three theories that govern gravimetry?
Answer: The law of mass action and reversible reactions, the principle of solubility product, and the common ion effect are the fundamental principles and theories of gravimetric analysis.

Q-5: What is the distinction between gravimetric and volumetric analysis?
Answer: Gravimetric and volumetric analysis are both quantitative methods for calculating the amount of sample in a solution or the purity of a compound; gravity analysis determines the mass of the analyte, while volumetric analysis determines the volume of the analyte.

Q-6: What do you mean by precipitation gravimetry?
Answer: Precipitation gravimetry is an analytical technique that uses a precipitation reaction to separate the ions in a solution. The precipitant, also known as the precipitating agent, is the chemical

that is used to cause precipitation. The analyte is precipitated from a sample solution and transformed into a compound with a known composition that can be weighed in precipitation gravimetry. It also has qualitative and quantitative applications.

Q-7: Determine the percentages of Na and K in a 0.6128 g sample containing NaCl and KCl treated with $AgNO_3$ yielded 1.039 g of dried AgCl (molecular weight= 143.32g/mol). NaCl and KCl have molecular weights of 58.44g/mol and 74.55g/mol respectively.

Answer: First calculate the moles of AgCl as follows:
n_{AgCl} = 1.039 g/(143.32g/mol) = 0.007250 mol

0.007250 mol = n_{NaCl} + n_{KCl}
0.6128 g = 58.44g/mol × n_{NaCl} + 74.55g/mol × n_{KCl}
Now, simplify and solve these two equations to calculate the percentage of Na in the sample.
0.6128 g = 58.44g/mol × (0.007250 mol - n_{KCl}) + 74.55g/mol × n_{KCl}
On solving
n_{KCl}= 0.01174 mol

Since one mole of KCl gives one mole of K, that means n_K= 0.01174 mol
Now, determine the mass of K using its molar mass (39.098 g/mol).

Thus,
m_K = 0.01174 mol × 39.098 g/mol = 0.4590 g
Finally, calculate the percentage of K as follows:
%K = (0.4590 g/0.6128 g) × 100 = 74.90%
%Na = 100-74.90 = 25.10%

Q-8: Name the process which contaminates the precipitates and also carries the precipitate solution containing soluble impurities.
a) Co-Precipitation
b) Super saturation
c) Re-precipitation
d) None of the above

Answer: a) Co-Precipitation
Explanation: The process of converting a precipitate into a dissolved state before precipitating it again is known as reprecipitation. It is a process used to remove impurities for a longer period of time in order to improve stoichiometry.

Supersaturation is a condition in which the solution has a higher solute concentration than the solvent. because the solution becomes saturated due to the correct proportion of solute and solvent

Both options b) and c) are incorrect because their definitions do not match the one given in the question.

Co-precipitation is the process which contaminates the precipitates and also carries the precipitate solution containing soluble impurities.

Q-9: What is the use of the sintered crucible in gravimetric analysis?
Answer: A sintered glass crucible is a Pyrex glass filtration device. Pyrex glass is a highly resistant glass.Precipitates are weighed after drying in an air oven in sintered crucibles.

Q-10: What are the limitations of gravimetric analysis?
Answer: The following are the various limitations of gravimetric analysis:

- It takes a long time to complete.
- Gravimetric analysis is typically limited to analysing a single element or a small group of elements at a time.
- Methods are frequently complicated, and a minor error in a procedure can often spell disaster for the analysis.
- Gravimetric analysis is based on mass measurement.

Q-11: What is the gravimetric analysis principle?
Answer: Gravimetric analysis is based on the difference in masses of two analyte-containing compounds. The idea behind gravimetric analysis is that the mass of an ion in a pure compound can be calculated and then used to calculate the mass percentage of the same ion in a specified volume of an impure compound.

Q-12: What conditions must be met in order for the analysis to be accurate?
Answer: Some of the requirements that must be met for the analysis to be accurate are as follows:

- The ion under investigation should be completely precipitated.
- The precipitate should be completely pure.
- The precipitate should easily filter out.

Q-13: What is meant by volatilization gravimetric analysis?
Answer: It is a type of gravimetric analysis, also known as physical gravimetry, that involves the separation of component mixtures by heating or chemically decomposing them.

Q-14: What is meant by electrodeposition type of gravimetric analysis?
Answer: It is a type of gravimetric analysis, also known as electrogravimetry, that separates and quantifies ions of a specific substance, most commonly a metal.

Q-15: What are the various applications of gravimetric analysis?

Answer:

- It is used to calibrate other instruments because this technology produces precise and widely correct data.
- One of the most common applications in medicine and biology is the determination of plasma volume.
- It can be used to determine the nickel content of stainless steel in a variety of industries.
- Chloride is determined using gravimetric methods.
- It is also used to help science students with hands-on experience grasp the concept.

Practise Questions on Gravimetric Analysis

Q-1: Determine the gravimetric factor for the analyte and precipitate listed below.
P is the analyte, and Ag_3PO_4 is the precipitate.

Answer: Calculate the formula weight of the precipitate, Ag_3PO_4 as follows:
Ag: 3×107.87 = 323.61
P: 1×30.97 = 30.97
O: 4×16.00 = 64.00

Formula weight = 323.61+30.97+64.00= 418.58 g/mol

Calculate the gravimetric factor:
Gravimetric factor = Weight of P/ Formula weight of Ag_3PO_4
= 30.97/418.58
= 0.0739 g P/ gAg_3PO_4

Q-2: Analyse the statements and select the correct option.

Statement I: The precipitate must have high solubility in order to be easily separated from the reaction mixture.
Statement II: Large-particle precipitates are frequently preferred for gravimetric analysis.

a) Both statements are incorrect
b) Only statement I is correct
c) Only statement II is correct
d) Both statements are correct

Answer: c) Only statement II is correct

Explanation: The precipitate generated by the precipitation reaction should have low solubility, high purity, and be easily separated from the solution, according to precipitation gravimetry. As a result, statement I is incorrect.

Q-3: How can we improve the sensitivity of the compound in the gravimetric analysis?

Answer: The sensitivity is used to determine the relationship between precipitate mass and analyte mass in the sample. Increase the ratio of precipitate molar mass to analyte molar mass in the sample to improve sensitivity. Also, if the analyte mass in the sample is lower, the obtained precipitate will be more sensitive.

Q-4: Why are large particles required in gravimetric analysis?

Answer: Larger-sized particles are required for gravimetric analysis because they are easily filtered and washed clean of impurities.

Q-5: Consider a natural water sample of 150 mL containing magnesium (Mg). Mg is calculated by precipitating the magnesium ion as magnesium oxide (molecular weight 40.3044 g/mol). The empty crucible was weighed at 37.4652 g and the crucible with precipitate was weighed at 37.0012g. Determine the Mg concentration in grams per 100 mL of water (mol. wt. 24.305 g/mol).

Answer: The mass of the MgO precipitate can be calculated as follows:
Mass of MgO = 37.4652-37.0012 = 0.4640 g
Number of moles of MgO = $(0.4640\ g)/(40.3044\ gmol^{-1}) = 0.01151$ mol

The number of moles of Mg in the sample is equal to the number of moles of MgO.
Hence, number of moles of moles of Mg = 0.01151 mol
Using the grams to the mole conversion factor to calculate the amount of Mg

Hence, the concentration of Mg in g/100 mL of water= 0.1865 g/ 100 mL.