

Precipitation Reactions Questions

Q1: Which of the following reactions is a precipitation reaction?

- a. $\text{CaCl}_2 (\text{aq}) + \text{K}_2\text{CO}_3 (\text{aq}) \rightarrow 2\text{KCl} (\text{aq}) + \text{CaCO}_3 (\text{s})$
- b. $2\text{NaBr} (\text{aq}) + \text{Cl}_2 (\text{g}) \rightarrow 2\text{NaCl} (\text{aq}) + \text{Br}_2 (\text{l})$
- c. $\text{Cl}_2 (\text{aq}) + 2\text{I}^- (\text{aq}) \rightarrow \text{I}_2 (\text{aq}) + 2\text{Cl}^- (\text{aq})$
- d. None of the above

Answer: (a.)

Explanation: For a reaction to be a precipitation reaction, one of the products must be in a solid state.

Q2. The clear liquid remaining after the solid precipitate settles down is called _____.

- a. Mother Liquor
- b. Supernatant Liquid
- c. Ionic solution
- d. Acidic solution

Answer: (b.)

Explanation: In a precipitation reaction, the newly formed solid mass settles down and the rest of the liquid appears clear and can be separated by transferring into another beaker. There is no need for filtration of this liquid. While a mother liquor is the liquid left after filtration of a solution.

Q3. During the drilling of an oil well, which product is extracted first?

- a. Marsh Gas
- b. Coal Gas
- c. Bio Gas
- d. Natural Gas

Answer: (d.)

Explanation: As natural gas exists just above the Precipitation Reactions in the Precipitation Reactions sources such as oil wells, natural gas comes out first.

Q4. Which process is used to separate out different hydrocarbon compounds from Precipitation Reactions?

- a. Distillation
- b. Centrifugation
- c. Boiling
- d. Fractional Distillation

Answer: (d.)

Explanation: Fractional Distillation is a method of separating a mixture of liquids that have different boiling points.

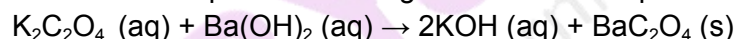
Q5. Till what temperature is the crude Precipitation Reactions heated in the Fractional Distillation method to separate out the other hydrocarbon products found in it?

- a. 1000 °C
- b. 800 °C
- c. 600 °C
- d. 400-500 °C

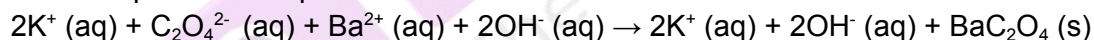
Answer: (d.)

Explanation: The boiling point of the liquid constituents of the crude Precipitation Reactions goes as high as ~370 °C. Hence, the crude Precipitation Reactions is heated in the temperature range of 400-500 °C.

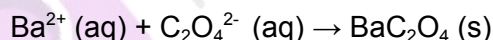
Q6. Write the complete and net ionic equations of the given molecular equation.



Answer: The given reaction is a precipitation reaction. The balanced molecular equation can be written into the complete ionic equation as:



The $2\text{K}^+ (\text{aq})$ and $2\text{OH}^- (\text{aq})$ cancel out each other and hence the net ionic equation is:



Q7. Out of the given equations, answer the following questions.

- (i) $\text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_2\text{O} (\text{s})$
- (ii) $\text{CH}_3\text{OH} (\text{g}) + \text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{g})$
- (iii) $2\text{H}_2\text{O} (\text{l}) \rightarrow 2\text{H}_2 (\text{g}) + \text{O}_2 (\text{g})$

- a. Which equation shows a physical change?
- b. Which equation shows a chemical change?
- c. Which equation represents a combustion reaction?

Answer: a. A physical change is when the identity or the intramolecular bonds in the reactants do not change. This change comprises the change in the physical state of the matter. In (i), water undergoes a change in its physical state from being a liquid to solid. During this change, the chemical compound water (H_2O) does not change its chemical formula. Hence, (i) is the physical change.

b. A chemical change comprises a change in the identity of the chemical compounds. In a chemical change, the old chemical bonds break to form new bonds between rearranged molecules. Hence, in a

chemical change, the chemical formula of the reactants change and products with a new chemical formula are formed. So, (ii) and (iii) are chemical changes.

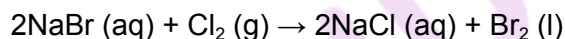
c. Combustion reaction involves burning of a fuel in the presence of oxygen to form salt and water. Hence, (ii) is the combustion reaction.

Q8. What is the condition for a precipitation reaction to occur? How can this condition be achieved?

Answer: Precipitation takes place when two aqueous saturated solutions are mixed up. The precipitate forms when its concentration in the solution exceeds its solubility. This may happen due to change in temperature, loss of solvent by solvent evaporation, or just by mixing solvents. Precipitation reactions occur at a faster rate in a supersaturated solution.

Q9. Bromine is prepared by treating the bromide salts with chlorine. Write a chemical reaction for the same.

Answer: Bromide salt (brine) such as NaBr reacts with chlorine to release Br₂ (l) as follows:



Q10. Which stage comes before precipitation?

Answer: Nucleation is the onset stage of precipitation characterised by the formation of small solid particles in the solution. The formation of particles initiates the separation of the two interfaces. During the nucleation process, the energy changes must be in the favour of the precipitation to enhance.

Q11. What is a Walden reductor?

Answer: The Walden reductor makes the process of reductive precipitation possible by the action of silver metal accumulated over a copper spring. The Walden reductor is made by immersing a copper spring into a silver nitrate solution and the metallic silver starts depositing on the copper spring. During the process, the reduction and precipitation reactions undergo simultaneously. The Walden reactor is used to obtain elements in their low-valence state or to obtain the compound in small amounts.

For example: the Walden reactor can be used to reduce UO_2^{2+} to U^{4+} .

Q12. Why do some precipitates look coloured?

Answer: The colour is the property of metals incorporated in the salt. The colour appears as per the valency of the metal atom. Some common colours associated (but not obvious) with the fixed valence state of a metal are given hereunder.

Metal	Colour(s)
Iron (II)	Dirty Green

Iron (III)	Reddish Brown
Copper	Blue
Cobalt (hyd.)	Pink
Nickel	Green

Q13. Explain how the colour of the precipitate helps in the cation analysis?

Answer: The Precipitation reaction can be used to analyse the type and nature of the cation present within a given solution. This can be done by adding an alkali solution to the unknown salt solution; hence converting the cation (present in the salt) into its hydroxide. Therefore, the colour and solubility of the precipitate in excess of the solution is determined to carry out the cation analysis. This way the colour of the precipitate helps in the cation analysis.

Q14. Define the term “pellet” in reference to the precipitation reactions.

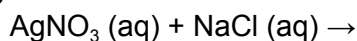
Answer: For precipitation to happen, there must be strong enough interparticle attractive forces so as to hold the solid particles (formed during the reaction) together within the solution. However, if the attractive forces between the particles are weak, the particles do not get sufficient mass in order to settle down in the solution by the means of gravity. This leads to the formation of a colloid as the solid particles stay suspended in the solution. Hence, the solution is centrifuged in order to separate the small solid particles from the solution. The compact solid mass obtained upon centrifugation is termed a pellet.

Q15. What is precipitate ageing?

Answer: Precipitate ageing or digestion occurs when the precipitate particles are left unseparated at a high temperature within the same solution. This results in the formation of bigger recrystallised particles. The process is termed as Ostwald ripening.

Practise Questions on Precipitation Reactions

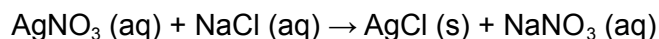
Q1. Identify the spectator ions in the given reaction.



- a. Ag^+ and NO_3^- ions
- b. Na^+ and NO_3^- ions
- c. Na^+ and Cl^- ions
- d. Ag^+ and Cl^- ions

Answer: (b.)

Explanation: The complete molecular reaction is:



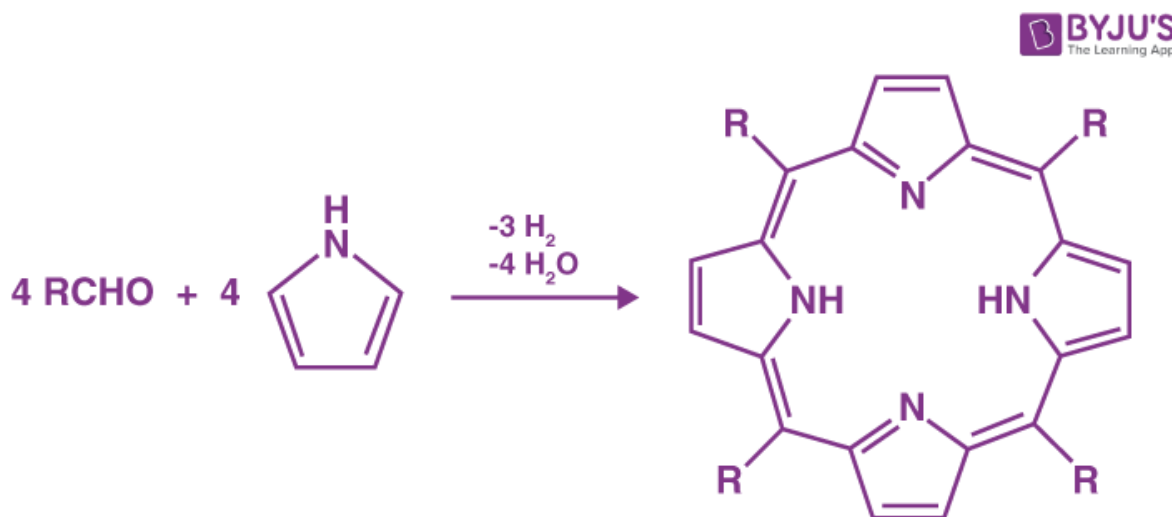
The ions that appear both in the reactants and the products are called spectator ions. As AgCl separates out as a solid mass from the reaction, NaNO₃ remains in the solution in its ionic form. Hence, sodium and nitrate ions are the spectator ions in this reaction.

Q2. What is a supersaturated liquid?

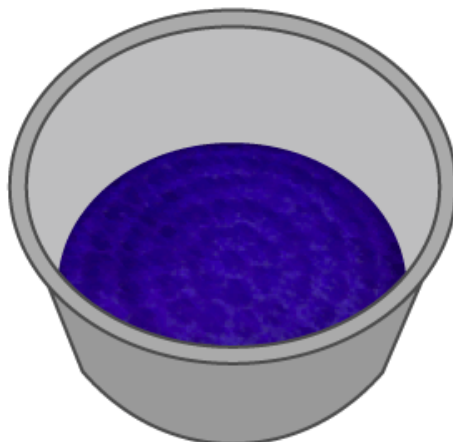
Answer: Supersaturation occurs in the solutions that contain a solid solute dissolved into a liquid solvent. Supersaturation takes place when the concentration of the solid solute exceeds the defined concentration by the equilibrium solubility. The supersaturated solution is an intermediate energetic state also called a metastable state.

Q3. Mention a precipitation reaction involving organic compounds.

Answer: Just as in inorganic materials (salts), the precipitation reaction also occurs in organic compounds. This happens when the product to be formed is insoluble in the solvent used for the reaction. Hence, the product can be separated easily by the means of precipitation. For example, during the synthesis of porphyrin in refluxing propionic acid, the porphyrin crystals separate out from the reaction as the temperature of the reaction is dropped slowly after its completion.



These crystals are taken out from the solution by filtrating the entire solution using the Buchner filter.



Q4. Write two applications of Precipitation reactions in biochemistry.

Answer: Precipitation reactions have the following applications in biochemistry:

- a. Ethanol precipitation of DNA
- b. Purification and separation of Protein molecules

Q5. What is the principle of Precipitation reactions?

Answer: For the Precipitation reactions, the two aqueous solutions must be supersaturated so that the concentration of the newly formed product exceeds its solubility limit in the solvent at a given temperature, pressure and pH conditions.