



Answer all the questions below as fully as you can then check your answers

1. What type of complex is usually formed when a metal ion with a 2^+ or 3^+ charge dissolves in water?

a) Tetrahedral b) Octahedral c) Square planar d) Linear

2. When anhydrous copper (II) sulfate is dissolved in water, what colour does the solution turn, and what complex ion is formed?

3. True or False

a. The formation of hexaaqua ions is an exothermic process.

4. Complete the sentence below by filling in the gap.

The energy released when one mole of gaseous ions is surrounded by water molecules, forming hydrated ions, is known as the _____.

5. Is the value of the enthalpy change of solution ($\Delta H_{\text{solution}}$) positive or negative for a substance when the hydration enthalpy is greater than the lattice enthalpy?

6. What happens to the solution's acidity when a metal (III) ion forms a hexaaqua complex in water?

- a) The solution becomes neutral.
- b) The solution becomes more basic.
- c) The solution becomes more acidic.
- d) The solution's pH remains constant.

7. What is formed when a hexaaqua complex containing a metal ion with a $3+$ oxidation state undergoes hydrolysis?

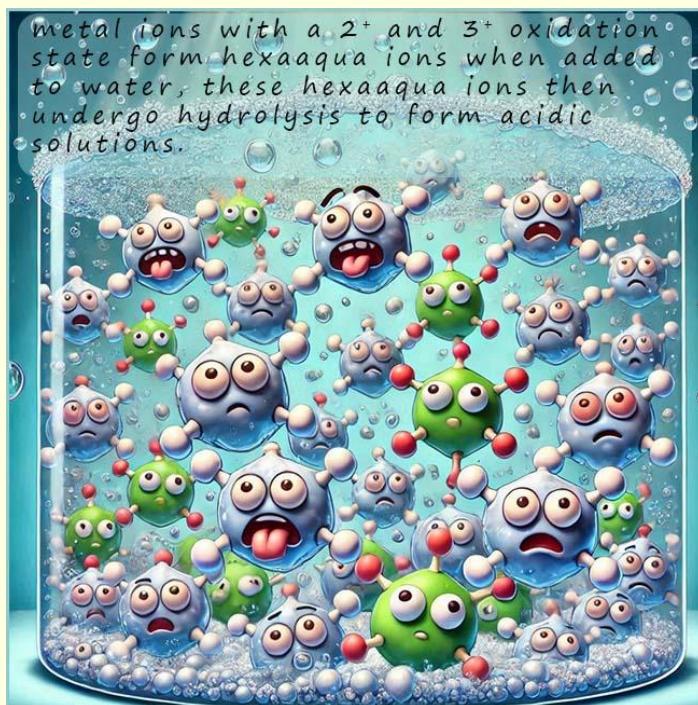
8. Given that the acid dissociation constant K_a for a metal (II) complex is 10^{-6} and for a metal (III) complex is 10^{-3} , which solution will have a lower pH and why?

9. Explain the process of hydrolysis in a hexaaqua complex and how the size-to-charge ratio of the metal ion affects the acidity of the solution.

10. Which of the following best describes the role of water molecules in the formation of hexaaqua complexes?

- a) Water acts as a neutral molecule that doesn't interact with the metal ion.
- b) Water molecules donate lone pairs to form coordinate bonds with the metal ion.
- c) Water molecules replace the metal ion in the complex.
- d) Water molecules act as an acid to donate H^+ ions to the metal ion.

11. What is the difference between the enthalpy of hydration and lattice enthalpy in the context of dissolving ionic compounds?



Answers

1. What type of complex is usually formed when a metal ion with a 2⁺ or 3⁺ charge dissolves in water?

- a) Tetrahedral b) Octahedral c) Square planar d) Linear

Answer: b) Octahedral

2. When anhydrous copper (II) sulfate is dissolved in water, what colour does the solution turn, and what complex ion is formed?

Answer:

The solution turns blue, and the complex ion formed is $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

3. True or False

- a. The formation of hexaaqua ions is an exothermic process.

Answer:

True. The formation of hexaaqua ions releases energy (enthalpy of hydration).

4. Complete the sentence below by filling in the gap.

The energy released when one mole of gaseous ions is surrounded by water molecules, forming hydrated ions, is known as the _____.

Answer: Hydration enthalpy

5. Is the value of the enthalpy change of solution ($\Delta H_{\text{solution}}$) positive or negative for a substance when the hydration enthalpy is greater than the lattice enthalpy?

Answer:

The enthalpy change of solution ($\Delta H_{\text{solution}}$) will be negative, indicating an exothermic dissolution process.

6. What happens to the solution's acidity when a metal (III) ion forms a hexaaqua complex in water?

- a) The solution becomes neutral.
- b) The solution becomes more basic.
- c) The solution becomes more acidic.
- d) The solution's pH remains constant.

Answer:

c) The solution becomes more acidic.

7. What is formed when a hexaaqua complex containing a metal ion with a 3⁺ oxidation state undergoes hydrolysis?

Answer:

The formation of $[M(H_2O)_5(OH)]^{2+}$ and the release of H_3O^+ (hydronium ion).

8. Given that the acid dissociation constant K_a for a metal (II) complex is 10^{-6} and for a metal (III) complex is 10^{-3} , which solution will have a lower pH and why?

Answer:

The metal (III) complex will have a lower pH because it has a larger K_a , indicating it is more acidic and undergoes more hydrolysis compared to the metal (II) complex.

9. Explain the process of hydrolysis in a hexaaqua complex and how the size-to-charge ratio of the metal ion affects the acidity of the solution.

Answer:

In a hexaaqua complex, the central metal ion pulls electron density from the water ligands, weakening the O-H bonds in the water molecules. This makes it easier for

hydrogen ions (H^+) to be released. The size-to-charge ratio of the metal ion influences the extent of polarization. A metal ion with a higher charge density

(such as a metal (III) ion) will polarize the water ligands more, leading to a greater loss of H^+ ions and resulting in a more acidic solution.

10. Which of the following best describes the role of water molecules in the formation of hexaqua complexes?

- a) Water acts as a neutral molecule that doesn't interact with the metal ion.
- b) Water molecules donate lone pairs to form coordinate bonds with the metal ion.
- c) Water molecules replace the metal ion in the complex.
- d) Water molecules act as an acid to donate H^+ ions to the metal ion.

Answer:

b) Water molecules donate lone pairs to form coordinate bonds with the metal ion.

11. What is the difference between the enthalpy of hydration and lattice enthalpy in the context of dissolving ionic compounds?

Answer:

The enthalpy of hydration is the energy released when gaseous ions are surrounded by water molecules, while lattice enthalpy is the energy required to break apart the ionic lattice into individual gaseous ions.