

Solubility Chemistry Questions with Solutions

Q1. If the solubility product constant of barium fluoride is 2.4×10^{-5} M, what is the solubility of barium fluoride?

- a.) 1.8×10^{-2} M
- b.) 3.5×10^{-3} M
- c.) 3.6×10^{-2} M
- d.) 4.9×10^{-3} M

Correct Answer- (a.) 1.8×10^{-2} M

Q2. For PbCl_2 , $K_{sp}=1.2 \times 10^{-5}$. Determine the maximum amount of grams of PbCl_2 that will dissolve in .250 L of water at 25°C .

- a.) 2.21 g
- b.) 1 g
- c.) 6.11 g
- d.) 3.88 g

Correct Answer- (b.) 1 g

Q3. Solubility product is-

- a.) The ion product of an electrolyte in its saturated solution
- b.) The product of the solubility of the ion of the electrolyte
- c.) The product of solubilities of the salt
- d.) The product of the concentration of the ions

Correct Answer. (a.) The ion product of an electrolyte in its saturated solution.

Explanation- The solubility product is the product of the concentration of ions in a saturated solution of an ionic compound.

Q4. What is needed to convert back and forth between solubility and molar solubility for a particular compound?

- a.) The density of the compound
- b.) The ionic charge of the compound
- c.) The molar mass of the compound
- d.) The lattice energy of the compound

Correct Answer. (c.) The molar mass of the compound

Q5. The solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid. This statement is based upon:

- a.) Raoult's law
- b.) Henry's law
- c.) Kohlrausch's law
- d.) None of the above

Correct Answer- (b.) Henry's law

Q6. What is the effect of temperature on the solubility of gas?

Answer. The solubility of a gas decreases as temperature rises. According to Charles's law, as the temperature rises, the volume of a given mass of gas is dissolved in the solution. As a result, water cannot retain gas, and the gas bubbles out.

Q7. What is the effect of pressure on the solubility of gases?

Answer. The solubility of gases is pressure-dependent: increasing pressure increases solubility while decreasing pressure decreases solubility. This statement is formalized in Henry's Law, which states that the solubility of a gas in a liquid is proportional to its pressure above the solution's surface.

This can be expressed mathematically as $C = K \times P_{\text{gas}}$.

C represents the solubility of a gas in a solvent.

K denotes the proportionality constant.

P_{gas} = partial pressure of a gas above a solution

Q8. What are the units of solubility?

Answer. Solubility is defined by the International Union of Pure and Applied Chemistry (IUPAC) as a ratio of solute to solvent. Molarity, molality, mass per volume, mole ratio, mole fraction, and other concentration units are authorised.

Q9. The molar solubility of PbBr_2 is $2.17 \times 10^{-3} \text{ M}$ at a certain temperature. Calculate K_{sp} for PbBr_2 .

Answer. For PbBr_2 the expression of solubility is $K_{\text{sp}} = [\text{Pb}^{2+}][\text{Br}^-]^2 = (S)(2S)^2 = 4S^3$

Substituting $S = 2.17 \times 10^{-3}$

$K_{\text{sp}} = 4S^3 = 4(2.17 \times 10^{-3})^3 = 4.1 \times 10^{-8}$

Q10. 1.5 g of solute is dissolved in 15 g of water to form a saturated solution at 298K. Find out the solubility of the solute at the temperature.

Answer. Mass of the solvent = 15 g

Solubility of the solute = [Mass of the solute/ Mass of the solvent] × 100

Solubility of the solute = [1.5/15] × 100
= 10 g.

Q11. The solubility of sodium nitrate at 50°C and 30°C is 114 g and 96 g, respectively. Find the amount of salt that will be thrown out when a saturated solution of sodium nitrate containing 50 g of water is cooled from 50°C to 30°C?

Answer. The amount of sodium nitrate dissolved in 100 g of water at 50°C is 114 g

∴ Amount of sodium nitrate dissolving in 50 g of water at 50°C is = [114 × 50] / 100
= 57 g.

Similarly, the amount of sodium nitrate dissolving in 50g of water at 30°C is = [96 × 50] / 100
= 48g

Amount of sodium nitrate thrown when 50g of water is cooled from 50°C to 30°C is
57 – 48 = 9 g

Q12. What are the factors affecting solubility?

Answer. The presence of other chemical species in a solution, the phases of the solute and solvent, temperature, pressure, solute particle size, and polarity can all affect solubility.

Q13. Calculate the solubility of Pb(OH)₂ in a buffer solution of pH =8. The solubility of Pb(OH)₂ in water is 6.7×10⁻⁶ M.

Answer. Pb(OH)₂ → Pb²⁺ + 2OH⁻

$K_{sp} = [Pb^{2+}][OH^{-}]^2 = S \times (2S)^2 = (6.7 \times 10^{-6}) (2 \times 6.7 \times 10^{-6})^2 = 1.2 \times 10^{-15}$

pOH = 14.0 - pH = 14 - 8 = 6

[OH⁻] = 10^{-pOH} = 10⁻⁶

Solubility of Pb(OH)₂ in the buffer solution-

$K_{sp} = [Pb^{2+}][OH^{-}]^2$

$1.2 \times 10^{-15} = [Pb^{2+}] \times (10^{-6})^2$

Solubility of Pb(OH)₂ = [Pb²⁺] = 1.2 × 10⁻³ M

Q14. The solubility of PbSO₄ in water is x. Calculate the solubility product constant of PbSO₄.

Answer. Given that the solubility of PbSO₄ is x.

PbSO₄ → Pb²⁺ + SO₄²⁻

$K_{sp} = [Pb^{2+}][SO_4^{2-}] = x \times x = x^2$

Hence, The solubility product constant of PbSO₄ is x².

Q15. The solubility of Pb(OH)₂ in water is 6.7×10⁻⁶ M. Calculate the solubility of Pb(OH)₂ in a buffer solution of pH=8.

Answer. The solubility of $\text{Pb}(\text{OH})_2$ in water is $6.7 \times 10^{-6} \text{ M}$
The expression for the solubility product is $K_{\text{sp}} = [\text{Pb}^{2+}][\text{OH}^-]^2$
 $K_{\text{sp}} = 4S^3$

Substituting values in the above equation,

$$K_{\text{sp}} = (6.7 \times 10^{-6})^3 \times 4 = 1.2 \times 10^{-15}$$

In buffer solution of pH 8, $\text{pOH} = 14 - 8 = 5$ or $[\text{OH}^-] = 10^{-5} \text{ M}$.

Substitute values in the expression for the solubility product.

$$1.2 \times 10^{-15} = [\text{Pb}^{2+}](10^{-5})^2$$

$$[\text{Pb}^{2+}] = 1.2 \times 10^{-3} \text{ M}$$

Therefore, the solubility of $\text{Pb}(\text{OH})_2$ in a buffer solution of pH = 8 is $1.2 \times 10^{-3} \text{ M}$.

Practise Questions on Solubility

Q1. Ag_3PO_4 would be least soluble at 25°C in-

- a.) 0.1 M AgNO_3
- b.) 0.1 M HNO_3
- c.) pure water
- d.) 0.1 M Na_3PO_4

Correct Answer- (a.) 0.1 M AgNO_3

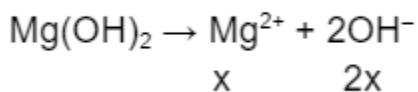
Q2. Which of the following gas will have the most solubility in water?

- a.) NH_3
- b.) H_2
- c.) O_2
- d.) He

Correct Answer- (a.) NH_3

Q3. If the solubility of $\text{Mg}(\text{OH})_2$ in water is 1.4×10^{-x} . $K_{\text{sp}} = 1.2 \times 10^{-11}$. Find out the value of x.

Answer.



$$K_{\text{sp}} = [\text{Mg}^{2+}][\text{OH}^-] = x \times (2x)^2 = 4x^3 = 1.2 \times 10^{-11}$$

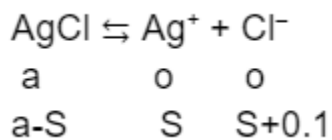
On comparison, $x = 4$.

Q4. Fill in the blank. At a given temperature, the solubility product is ____.

Answer. At a given temperature, the solubility product is constant.

Q5. What will be the solubility of AgCl(s) with solubility product 1.6×10^{-10} in 0.1 M NaCl solution?

Answer.



$$K_{sp} = 1.6 \times 10^{-10} = [\text{Ag}^+][\text{Cl}^-]$$

$$= S(0.1 + S)$$

Since, K_{sp} value seems to be very small, the value of S can be ignored, with respect to 0.1 M.

$$1.6 \times 10^{-10} = S \times 0.1$$

$$S = 1.6 \times 10^{-9} \text{ M}$$

The solubility of AgCl(s) with solubility product 1.6×10^{-10} in 0.1 M NaCl solution is 1.6×10^{-9} M.