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 Charle'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 $C=K\times P_{gas}$.
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 2.17×10^{-3} M at a certain temperature. Calculate K_{sp} for $PbBr_2$.

Answer. For $PbBr_2$ the expression of solubility is $K_{sp} = [Pb^{2+}][Br^-]^2 = (S)(2S)^2 = 4S^3$
Substituting $S = 2.17 \times 10^{-3}$
$K_{sp} = 4S^3 = 4(2.17 \times 10^{-3})^3 = 4.1 \times 10^{-8}$

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. $Pb(OH)_2 \rightarrow Pb^{2+} + Cl^-$
$K_{sp} = [Pb^{2+}][OH^-] = S \times (2S)^2 = (6.7\times10^{-6})\ (2 \times 6.7\times10^{-6})^2 = 1.2 \times 10^{-15}$
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 $Pb(OH)_2 = [Pb^{2+}] = 1.2 \times 10^{-3}$ M

Q14. The solubility of $PbSO_4$ water is x. Calculate the solubility product constant of $PbSO_4$.

Answer. Given that the solubility of $PbSO_4$ is x.
$PbSO_4 \rightarrow Pb^{+2} + SO_4^{2-}$
$K_{sp} = [Pb^{+2}][SO_4^{-2}] = x \times x = x^2$
Hence, The solubility product constant of $PbSO_4$ is x^2.

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 $Pb(OH)_2$ in water is 6.7×10^{-6} M
The expression for the solubility product is $K_{sp} = [Pb^{2+}][OH^-]^2$
$K_{sp} = 4S^3$
Substituting values in the above equation,
$K_{sp} = (6.7 \times 10^{-6})^3 \times 4 = 1.2 \times 10^{-15}$
In buffer solution of pH 8, pOH = 14 - 8= 5 or $[OH^-] = 10^6$ M.
Substitute values in the expression for the solubility product.
$1.2 \times 10^{-15} = [Pb^{2+}](10^{-6})^2$
$[Pb^{2+}] = 1.2 \times 10^{-3}$ M
Therefore, the solubility of $Pb(OH)_2$ in a buffer solution of pH = 8 is 1.2×10^{-3} M.

Practise Questions on Solubility

Q1. Ag_3PO_4 would be least soluble at 25℃ 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 $Mg(OH)_2$ in water is 1.4×10^{-x}. $K_{sp} = 1.2\times10^{-11}$. Find out the value of x.

Answer.

$$Mg(OH)_2 \rightarrow \underset{x}{Mg^{2+}} + \underset{2x}{2OH^-}$$

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

$$AgCl \leftrightarrows Ag^{+} + Cl^{-}$$

a	o	o
a-S	S	S+0.1

$K_{sp} = 1.6\times10^{-10} = [Ag^{+}][Cl^{-}]$
$= S\ (0.1 + S)$
Since, K_{sp} value seems to be very small, the value of S can be ignored, with respect to 0.1 M.
$1.6\times10^{-10} = S \times 0.1$
$S = 1.6\times10^{-9}$ 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.