41. **(a) The ionic product of an electrolyte in its saturated solution**

Explanation (Word-Friendly):

Solubility product (**Ksp**) applies to **sparingly soluble salts only**.

In a **saturated solution**, the electrolyte dissociates into ions.

At equilibrium, the **product of concentrations of ions** remains **constant**.

This constant is called **solubility product (Ksp)**.

Example:

For the salt:

$AB \rightleftharpoons A^+ + B^-$

Solubility product:

$Ksp = [A^+] \times [B^-]$

42. (d) K_w increases with increase in temperature.

43. (b) It contains two cations and one anion.

44. (a) $HgSO_4$of $K_{sp} = S^2$

$S = \sqrt{K_{sp}}$; $\boldsymbol{S = \sqrt{6.4 \times 10^{-5}}}$; $\boldsymbol{S = 8 \times 10^{-3}} m/l.$

45. (b) The solubility of $BaSO_4$in $g/litre$ is given 2.33×10^{-3}

$\because$in $mole/litre.\boldsymbol{n} = \frac{\boldsymbol{W}}{\boldsymbol{m.wt}} = \boldsymbol{1 \times 10^{-5}} = \frac{2.33\times10^{-3}}{233}$

Because $BaSO_4$is a compound

$\boldsymbol{K_{sp} = S^2 = [1 \times 10^{-5}]^2 = 1 \times 10^{-10}}$

46. (d) $\underset{a}{AgCl} \rightleftharpoons \underset{a}{Ag^+} + \underset{a}{Cl^-}$

$\underset{\mathbf{0.02}}{\boldsymbol{NaCl}} \rightleftharpoons \underset{0.02}{Na^+} + \underset{0.02}{Cl^-}$

$K_{sp}AgCl = 1.20 \times 10^{-10}$

$\boldsymbol{K_{sp}AgCl = [Ag^+][Cl^-] = a \times [a + 0.2] = a^2 + 0.2a}$

a^2 is a very small so it is a neglected.

$K_{sp}AgCl = 0.2a$

$1.20 \times 10^{-10} = 0.2a$

$a = \frac{1.20\times10^{-10}}{0.20} = 6 \times 10^{-10} mole$

47. (b) Solubility is decreased due to common ion effect.

$AgI \rightleftharpoons Ag^+ + \boxed{I^-}$ Common ion

$NaI \rightleftharpoons Na^+ + \boxed{I^-}$

48. (c) K_{sp} of $BaSO_4 = 1.5 \times 10^{-9}$; $Ba^{++} = 0.01M$

$SO_4^{--} = \frac{1.5\times10^{-9}}{0.01} = 1.5 \times 10^{-7}$

49. (c) $AgCrO_4 \rightleftharpoons \underset{(2S)^2}{2Ag^+} + \underset{S}{CrO_4^-}$

$\boldsymbol{K_{sp} = 4S^3}$ given $\boldsymbol{2S = 1.5 \times 10^{-4}}$

$\therefore \boldsymbol{K_{sp} = (2S)^2 \times S}$

$= \boldsymbol{(1.5 \times 10^{-4})^2 \times \left(\frac{1.5\times10^{-4}}{2}\right) = 1.6875 \times 10^{-12}}$

50. (c) $PbCl_2 \rightleftharpoons \underset{S}{Pb^{2+}} + \underset{S}{2Cl^-}$

$\boldsymbol{K_{sp}}$of $\boldsymbol{PbCl_2 = [Pb^{2+}] \times [Cl^-]^2}$;$\boldsymbol{K_{sp} = S \times (2S)^2}$

$\boldsymbol{K_{sp} = S \times 4S^2 = 4S^3; S^3 = \frac{K_{sp}}{4}}; S = \sqrt[3]{\frac{K_{sp}}{4}}$

51. (b) $AgCl \rightleftharpoons [Ag^+][Cl^-]$;$K_{sp} = S \times S$; $\boldsymbol{K_{sp} = S^2}$

$\boldsymbol{S = \sqrt{K_{sp}} = \sqrt{1.44 \times 10^{-4}} = 1.20 \times 10^{-2}} M.$

52. (d) By formula $BA_2 \rightarrow B^+ + 2A^-$

$K_{sp} = 4x^3$

53. (a) $\underset{S}{AgCrO_4} \rightarrow \underset{2S}{2Ag^+} + \underset{S}{CrO_4^{--}}$

$\boldsymbol{K_{sp} = (2S)^2 S = 4S^3}$

$\boldsymbol{S = \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}} = \left(\frac{32\times10^{-12}}{4}\right)^{\frac{1}{3}} = 2 \times 10^{-4}} M.$

54. (d) Common ion effect is noticed only for weak electrolyte dissociation. H_2SO_4 is strong electrolyte.

55. (c) When we added barium ion in chromate ion solution we obtained yellow ppt of $BaCrO_4$.

$BaCl_2 + K_2CrO_4 \rightarrow \underset{\text{Yellow ppt.}}{BaCrO_4} \downarrow +2KCl$

56. (d) *AB is a* binary electrolyte.

$S = \sqrt{K_{sp}} = \sqrt{1.21 \times 10^{-6}} = 1.1 \times 10^{-3} M$

57. (b) Precipitation occurs when ionic product > solubility.

58. (c) For a binary electrolyte, so that

$K_{sp} = S \times S = S^2$

$\boldsymbol{S = \sqrt{K_{sp}}}.$

59. **(d) The value of ionic product is greater than the value of solubility product**

Explanation (Word-Friendly):

Ionic Product (IP): Actual concentration of ions in a solution

Solubility Product (Ksp): Maximum concentration of ions that can exist without forming a precipitate

Condition	Result
IP < Ksp	No precipitate (solution is unsaturated)

Condition	Result
IP = Ksp	Saturated solution (equilibrium) – no precipitate
IP > Ksp	Precipitate forms

Therefore, precipitation occurs only when:

Ionic Product > Solubility Product (Ksp)

60. (c) Let solubility of AgCl = S

$AgCl \rightleftharpoons Ag^+ + Cl^-$

Ksp = (concentration of Ag^+) × (concentration of Cl^-)

Ksp = S × 0.08

So,

S = Ksp / 0.08

S = $(4.0 \times 10^{-10}) / 0.08$

S = 5.0×10^{-9} M