

Solubility Equilibrium Assignment

- Are the following compounds soluble or insoluble in water? Use the solubility rules to make your predictions. (12 marks)

a) PbSO ₄	b) AgI	c) Na ₂ CO ₃
d) FeS	e) AgNO ₃	f) Cu(OH) ₂
g) AlCl ₃	h) CaSO ₄	i) CuSO ₄
j) LiOH	k) BaCO ₃	l) Na ₂ S
- Predict whether or not a precipitate will form when aqueous solutions of the following pairs of substances are mixed together. Write a balanced chemical equation for each reaction. (8 marks)
 - sodium carbonate + calcium chloride ->
 - iron (III) chloride + sodium hydroxide ->
 - sodium nitrate + calcium bromide ->
 - barium chloride + potassium hydroxide ->
 - lead (II) nitrate + sulphuric acid ->
 - hydrochloric acid + lead (II) nitrate ->
 - silver nitrate + sodium iodide ->
 - barium chloride + magnesium sulfate ->
- Calculate the solubility of Hg₂C₂O₄ in mol/L. (K_{sp} = 1.0*10⁻¹³). (5 marks)
$$\text{Hg}_2\text{C}_2\text{O}_4(\text{s}) \rightleftharpoons \text{Hg}_2^{+2}(\text{aq}) + \text{C}_2\text{O}_4^{-2}(\text{aq})$$
- The solubility of Cr(OH)₃ in water is 5.62 ug per litre. What is the value of the solubility product constant for Cr(OH)₃? 1 ug = 0.000001 g. (6 marks)
- The solubility product constant of lead (II) hydroxide is 4.2*10⁻¹⁵ mol³/L³. What is the molar concentration of Pb⁺² in a saturated solution of lead (II) hydroxide? (5 marks)
- It is found that 0.06 g of lead (II) sulfate will dissolve in 2.0 L of water. What is the solubility product constant for PbSO₄? (5 marks)
- Calculate the solubility of Ca₃(PO₄)₂ in mol/L. K_{sp} = 1.0*10⁻²⁵. (3 marks)
- The solubility of PbS in water is 4.41 pg/L. What is the value of the solubility product constant for PbS? 1 picogram = 1*10⁻¹² g. (5 marks)
- Calculate the solubility of lithium phosphate in mol/L. K_{sp} = 3.2*10⁻¹³. (3 marks)
- The solubility of MgF₂ in water is 0.0012M. What is the K_{sp} of MgF₂? (3 marks)
- The solubility product constants of iron (II) hydroxide and iron (III) hydroxide are 1.8*10⁻¹⁵ mol³/L³ and 6.0*10⁻³⁸ mol⁴/L⁴ respectively. Which of these two hydroxides is the least soluble? Why? (2 marks)

12. The solubility of CaF_2 in water is 16.8 mg/L. What is the value of the K_{sp} ? (5 marks)
13. What are the solubility product constant expressions for $\text{Fe}(\text{OH})_3$ and $\text{Ca}_3(\text{PO}_4)_2$? (2 marks)
14. Calculate the K_{sp} of $\text{Fe}(\text{OH})_3$ if 4.8×10^{-14} g just saturates 1.0 cm^3 of water. (5 marks)
15. The K_{sp} for AgCl is $1.7 \times 10^{-10} \text{ mol}^2/\text{L}^2$. Calculate the mass of silver chloride that will dissolve in 250 mL of water. (5 marks)
16. What is the solubility of PbCl_2 in a 1.00 M hydrochloric acid solution? (3 marks)
17. What is the solubility, at 25°C , of calcium fluoride in each of the following solutions? (9 marks)
a) pure water b) 0.01M calcium chloride (aq) c) 0.1M sodium fluoride (aq)
18. What mass of BaF_2 will dissolve in 500 mL of a 0.20 M BaCl_2 solution. (5 marks)
19. An aqueous solution is 0.0010 M in $\text{F}^-(\text{aq})$ and 0.010 M in $\text{CO}_3^{2-}(\text{aq})$. A concentrated aqueous solution of MgCl_2 is added. Assuming both are possible precipitates, which one would precipitate out first, MgF_2 or MgCO_3 ? (8 marks)
20. Copper (I) chloride has a $K_{\text{sp}} = 1.9 \times 10^{-7}$. Calculate the molar solubility in: (12 marks)
a) pure water b) 0.01 M HCl c) 0.1 M HCl d) 0.1 M MgCl_2
21. Should a precipitate of PbCl_2 form when 50 mL of 0.10 M lead (II) nitrate solution is added to 100 mL of a 0.05 M sodium chloride solution? (5 marks)
22. Will a precipitate form if 200 cm^3 of a 0.00006 mol/L $\text{Ca}(\text{NO}_3)_2$ solution and 100 cm^3 of a solution containing 9.8×10^{-10} g of H_3PO_4 are mixed together? K_{sp} of $\text{Ca}(\text{NO}_3)_2 = 1.0 \times 10^{-25}$. (7 marks)
23. Will a precipitate form if 100 cm^3 of a 0.003 M solution of $\text{Cu}(\text{NO}_3)_2$ is mixed with 150 cm^3 of a 0.0006 M solution of K_2S ? K_{sp} of $\text{CuS} = 1.6 \times 10^{-14}$. (5 marks)
24. Will a precipitate form if you mix 50 mL of a 1.00 M $\text{KOH}(\text{aq})$ with each of the following?
a) 50 mL of a 0.0010 M barium chloride solution
b) 50 mL of a 1.00 M barium chloride solution
25. Suppose we mix 50 mL of a 2.00 M $\text{NaCl}(\text{aq})$ with 50 mL of a 0.020 M $\text{AgNO}_3(\text{aq})$.
a) How many grams of silver chloride will precipitate from the solution?
b) What concentrations of silver ion remains in solution after the precipitate has formed? (10 marks)