

Unit III – Assignment 1 – Solubility

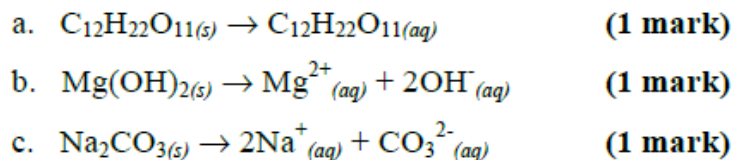
1. Define *solubility*. (2 marks)

Answer: The maximum amount of solute that will dissolve in a given amount of solvent.
or
The concentration of a saturated solution. (2 marks)

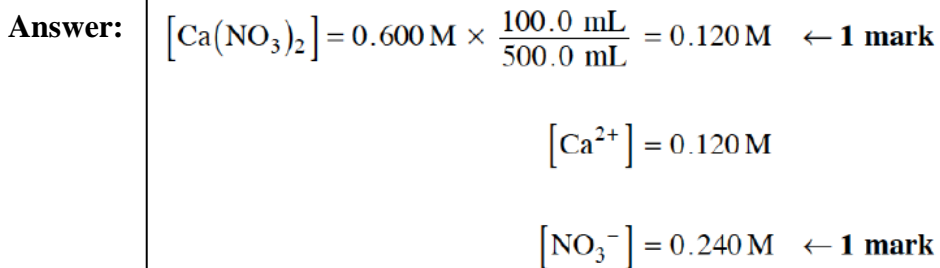
2. Write chemical equations to represent the equilibria for saturated solutions of the following chemicals: (3 marks)

- a. Syrup, $C_{12}H_{22}O_{11(s)}$
b. Milk of magnesia, $Mg(OH)_{2(s)}$
c. Washing soda, $Na_2CO_{3(s)}$

Answers:



3. A 100.0 mL sample of 0.600 M $Ca(NO_3)_2$ is diluted by adding 400.0 mL of water. Calculate the concentration of ions in the resulting solution. (2 marks)



Unit III – Assignment 1 – Solubility

4. Determine the molar concentration of each ion from the solubility of the following saturated solutions:

a. Rock phosphorus, $\text{Ca}_3(\text{PO}_4)_2(s)$ at 1.4×10^{-7} mol/L at 25°C (3 marks)

b. Rock salt, $\text{NaCl}(s)$ at 32.2 g/100 mL at 25°C (4 marks)

Answer:

$$\begin{aligned} \text{a. } [\text{Ca}^{2+}] &= 3(1.4 \times 10^{-4} \text{ M}) = 4.2 \times 10^{-4} \text{ M} \\ [\text{PO}_4^{3-}] &= 2(1.4 \times 10^{-4} \text{ M}) = 2.8 \times 10^{-4} \text{ M} \end{aligned}$$

$$\begin{aligned} \text{b. } (32.2 \text{ g} / 0.100 \text{ L}) (1 \text{ mol} / 58.5 \text{ g}) &= 5.50 \text{ M} \\ [\text{Na}^+] &= [\text{Cl}^-] = 5.50 \text{ M} \end{aligned}$$

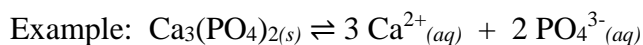
5. A 100 ml solution containing 0.2 M Al^{3+} , 0.2 M NH_4^+ and 0.2 M Mg^{2+} is added to a 100 ml solution containing 0.2 M S^{2-} , 0.2 M Cl^- and 0.2 M OH^- . Identify the ions that do **not** form a precipitate. (2 marks)

Answer: NH_4^+ and Cl^- ← 2 marks

6. Write a balanced chemical equation for the equilibrium in a saturated solution of an ionic compound with low solubility. (2 marks)

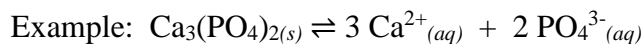
Answer:

Any EQM equation as long as it has low solubility.



7. Write an equation that describes the equilibrium present in a saturated solution of $\text{Cu}_3(\text{PO}_4)_2$. (2 marks)

Answer:



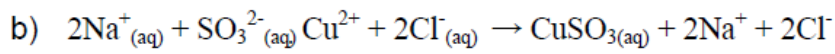
Unit III – Assignment 1 – Solubility

8. A 1.0 M solution of sodium sulphite is added to a 1.0 M solution of copper(II) chloride resulting in the formation of a precipitate.

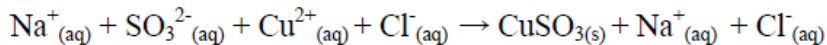
- Identify the precipitate. (1 mark)
- Write the complete ionic equation for the reaction. (1 mark)
- Identify all spectator ions. (1 mark)

Answer:

Copper(II) sulphite or CuSO_3



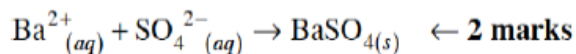
or



c) Na^+ , Cl^-

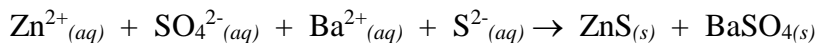
9. Write the net ionic equation representing the reaction that occurs when equal volumes of 0.20 M H_2SO_4 and 0.20 M $\text{Ba}(\text{NO}_3)_2$ are mixed together. (2 marks)

Answer:



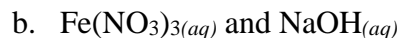
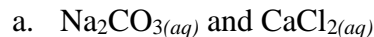
10. Write the net ionic equation representing the reaction that occurs when 50.0 mL of 0.20 M ZnSO_4 and 50.0 mL of 0.20 M BaS are combined. (2 marks)

Answer:



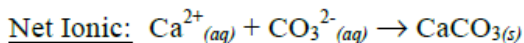
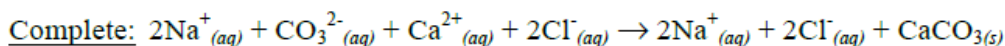
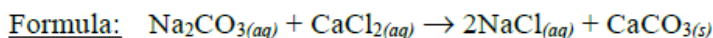
Unit III – Assignment 1 – Solubility

11. Write the formula equation, complete ionic, and net ionic equations for the following double replacement reactions: **(6 marks)**

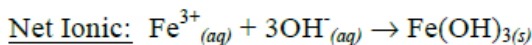
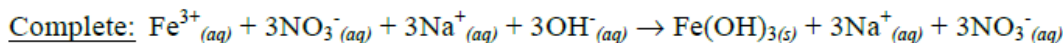
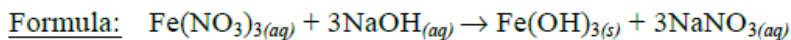


Answers:

a. **(1 mark for each)**



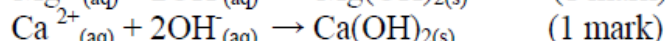
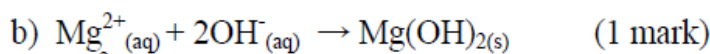
b. **(1 mark for each)**



12. a) Identify a compound that could be used to precipitate both the $\text{Mg}^{2+}_{(aq)}$ and $\text{Ca}^{2+}_{(aq)}$ from “hard water”. **(1 mark)**

b) Write the net ionic equations for the reactions. **(2 marks)**

Answer: Add NaOH to precipitate Mg^{2+} and Ca^{2+} .

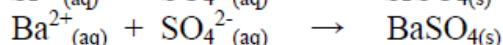
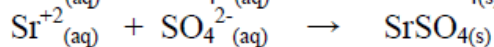
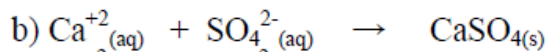


13. A solution contains 0.20 M Cl^- and 0.20 M SO_4^{2-} .

a) Identify a cation that could be added to the solution to give a precipitate with only one of these anions. **(1 mark)**

b) Write the net ionic equation for the precipitation reaction in part a). **(1 mark)**

Answer: For example: Ca^{+2} or Sr^{+2} or Ba^{+2}



Unit III – Assignment 1 – Solubility

14. Write an experimental design to determine whether one or both of $\text{Ag}^+_{(aq)}$ or $\text{Ba}^{2+}_{(aq)}$ are present in a waste solution from a commercial establishment.
(4 marks)

Answer:

Add NaCl, if a ppt forms, Ag^+ ions are present. If no ppt, no Ag^+ ions in the waste solution. Next add Na_2SO_4 to test for the presence of Ba^{2+} . If a ppt forms, Ba^{2+} is present.
