Marks 7

- Write the equation for the dissolution of lead(II) chloride, $PbCl_2$, in water.

Write the expression for the solubility product constant, K_{sp}, for $PbCl_2$.

What $[Cl^-]$ is needed to reduce the $[Pb^{2+}]$ to the maximum safe level of 0.015 mg L^{-1}? $K_{sp}(PbCl_2) = 1.6 \times 10^{-6}$

$[Cl^-]$ =

The solubility of sodium chloride is 359 g L^{-1}. If a reservoir of 50,000 L is saturated with lead(II) chloride, can sodium chloride be used to reduce the $[Pb^{2+}]$ to a safe level? If so, what mass of sodium chloride (in kg) would be needed?

Answer:

Would the water in the reservoir be fit for drinking? Explain your answer.

Marks 8

- The concentration of iron in the ocean is one of the primary factors limiting the growth rates of some basic life forms. Write the chemical equation for the dissolution reaction of $Fe(OH)_3$ in water.

What is the solubility of $Fe(OH)_3$ in mol L^{-1}? K_{sp} ($Fe(OH)_3$) is 2.8×10^{-39} at 25 °C.

Answer:

Before the Industrial Revolution, the concentration of $OH^-(aq)$ in the oceans was about 1.6×10^{-6} M. What pH corresponds to this concentration at 25 °C?

Answer:

What is the solubility of $Fe(OH)_3$ in mol L^{-1} at this pH?

Answer:

Industrialisation has led to an increase in atmospheric CO_2. Predict the effect that this has had on the amount of $Fe^{3+}(aq)$ in sea water and briefly explain your answer.

Marks
6

- Explain what is meant by the "common ion effect".

Magnesium hydroxide is sparingly soluble. Write down the chemical equation for its dissolution in water and the expression for K_{sp}.

What is the molar solubility of magnesium hydroxide in water? $K_{sp} = 7.1 \times 10^{-12}$

Answer:

What is the pH of a saturated solution of magnesium hydroxide in water?

Answer:

What is the molar solubility of magnesium hydroxide in a buffer solution at pH 9.24? **Marks 3**

Answer:

Do the relative solubilities of magnesium hydroxide in water and the buffer solution support the concept of the common ion effect? Explain your reasoning.

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

Marks 5

- Nickel metal can be extracted and recycled from mobile phone batteries. This process leads to solutions containing both $Cu^{2+}(aq)$ and $Ni^{2+}(aq)$ ions. Separation of these ions is achieved by adding tiny amounts of sulfide ions as the metal sulfides have low and very different solubilities: $K_{sp}(CuS) = 8 \times 10^{-34}$ and $K_{sp}(NiS) = 3 \times 10^{-19}$.

  An aqueous solution has $[Ni^{2+}(aq)] = 0.0100$ M and an unknown concentration of $Cu^{2+}(aq)$ ions. $S^{2-}(aq)$ ions are added in small increments. CuS begins to precipitate when $[S^{2-}(aq)] = 8 \times 10^{-32}$ M. What was the original value of $[Cu^{2+}(aq)]$?

Answer:

At what $[S^{2-}(aq)]$ will NiS precipitate?

Answer:

If the CuS formed is filtered off before any NiS precipitates, how pure will the NiS precipitate be?

Answer:

Page Total:

Marks 6

- The pH of the ocean before the industrial revolution was around 8.22. Show that this pH corresponds to a concentration of $[OH^-(aq)] = 1.7 \times 10^{-6}$ M.

All forms of life depend on iron and the concentration of iron in the oceans and elsewhere is one of the primary factors limiting the growth rates of the most basic life forms. One reason for the low availability of iron(III) is the insolubility of the hydroxide, $Fe(OH)_3$, which has a K_{sp} of only 1×10^{-39}. What was the maximum concentration of $Fe^{3+}(aq)$ at a pH of 8.22?

Answer:

Industrialisation has led to an increase in atmospheric CO_2. What effect has this had on the amount of $Fe^{3+}(aq)$ in sea water?

- $BaSO_4$ is used as a contrast agent for X-ray images of intestines. What is the solubility product constant, K_{sp}, for $BaSO_4$, given that a maximum of 1.2×10^{-3} g dissolves in 500 mL of water. **4**

Answer:

Ba^{2+} ions are toxic. Comment on the suitability of $BaSO_4$ as a contrast agent.

What advantage would there be in administering $BaSO_4$ as a slurry which also contains 0.5 M Na_2SO_4?

- The K_{sp} of $Fe(OH)_3$ is 2.0×10^{-39} M^4. What is the solubility of $Fe(OH)_3$ in g L^{-1}? **5**

Answer:

What effect does lowering the pH have on the solubility of $Fe(OH)_3$? Explain your answer.