Exercise walk-through

pH and Solubility ▪ 8.11

eXercise

You must be able to

- explain why salts of **weak-acid anions** dissolve more in acid
- use Le Chatelier on the solubility equilibrium
- predict the effect of lowering pH

Method — Acid dissolves basic-anion salts

If a salt's anion is the conjugate base of a **weak acid** (e.g. CO_3^{2-}, F^-, OH^-), adding acid removes that anion (it reacts with H^+), so **more** salt dissolves.

Method — The Le Chatelier view

$CaCO_3(s) \rightleftharpoons Ca^{2+} + CO_3^{2-}$. Add H^+: it consumes CO_3^{2-} (forming HCO_3^-/H_2CO_3), so the equilibrium shifts **right** — more solid dissolves.

Method — No effect for strong-acid anions

Salts whose anion is from a **strong** acid (e.g. Cl^-, NO_3^-) are **not** affected by pH — those anions do not react with H^+.

Method — A worked prediction

$Mg(OH)_2$ dissolves more in acid: H^+ removes OH^-, shifting the dissolution right. AgCl is unaffected by pH (Cl^- is a spectator).

Practice 2.1 ▪ 1 mark

Does adding acid increase the solubility of $CaCO_3$?

Solution 2.1

Method: Acid dissolves basic-anion salts

Worked steps

Yes B1.

Practice 2.2 ▪ 1 mark

Why is AgCl solubility unaffected by pH?

Solution 2.2

Method: A worked prediction

Worked steps

Cl^- is the anion of a strong acid, so it does not react with H^+ B1.

Practice 2.3 ▪ 1 mark

Adding H^+ to a hydroxide salt removes which ion?

Solution 2.3

Method: Acid dissolves basic-anion salts

Worked steps

OH^- B1.

Exam-style 3.1 ▪ 1 mark

Lowering the pH increases the solubility of a salt whose anion is

A the conjugate base of a weak acid

B from a strong acid

C a metal

D always insoluble

Solution 3.1

A the conjugate base of a weak acid ✓

B from a strong acid

C a metal

D always insoluble

Worked steps

A — the conjugate base of a weak acid.

Exam-style 3.2 ▪ 1 mark

Consider $CaF_2(s) \rightleftharpoons Ca^{2+} + 2F^-$. Acid is added.
(a) State the effect on solubility.
(b) Explain using Le Chatelier's principle (note F^- is a weak-acid anion).

Solution 3.2

Worked steps

(a) It increases B1. (b) H^+ reacts with F^- to form HF, removing F^-; the equilibrium shifts right to replace it, dissolving more CaF_2 M1 A1.

Exam-style 3.3 ▪ 2 marks

Explain why NaCl solubility does not change with pH but $Mg(OH)_2$ does.

Solution 3.3

Worked steps

Cl^- is a strong-acid anion that does not react with H^+, so pH has no effect; OH^- reacts with H^+, so lowering pH dissolves more $Mg(OH)_2$ M1 A1.