AP CHEMISTRY • EXERCISE SHEET

8.11 pH and Solubility

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on **pH and solubility** —how acid affects solubility.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

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.

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.

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^+.

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).

2 Practice

Now apply the methods above.

2.1 Does adding acid increase the solubility of $CaCO_3$? [1]

2.2 Why is AgCl solubility unaffected by pH? [1]

2.3 Adding H^+ to a hydroxide salt removes which ion? [1]

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3 Exam-style questions

3.1 Lowering the pH increases the solubility of a salt whose anion is [1]

- **A** the conjugate base of a weak acid
- **B** from a strong acid
- **C** a metal
- **D** always insoluble

3.2 Consider $CaF_2(s) \rightleftharpoons Ca^{2+} + 2F^-$. Acid is added.

(a) State the effect on solubility. [1]

(b) Explain using Le Chatelier's principle (note F^- is a weak-acid anion). [2]

3.3 Explain why NaCl solubility does not change with pH but $Mg(OH)_2$ does. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **8.11 pH and Solubility** lesson on the **Learn** page;
- read the **pH and Solubility** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 Yes.

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

2.3 OH^-.

3.1 **A** —the conjugate base of a weak acid.

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

3.3 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 $Mg(OH)_2$.