AP CHEMISTRY • EXERCISE SHEET

3.10 Solubility

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **solubility** —"like dissolves like".

You must be able to:

- apply the rule **like dissolves like** (polar dissolves polar, nonpolar dissolves nonpolar)
- predict whether a solute dissolves in a given solvent
- explain solubility with intermolecular forces

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.

Like dissolves like

A solute dissolves best in a solvent with **similar** intermolecular forces:

- **polar/ionic** solutes dissolve in **polar** solvents (water);
- **nonpolar** solutes dissolve in **nonpolar** solvents (oil, hexane).

Why it works

Dissolving requires the solute-solvent attractions to be comparable to the attractions being broken. Water can hydrate ions and hydrogen-bond to polar molecules, but has nothing to offer a nonpolar molecule.

A worked prediction

Will NaCl dissolve in water? Yes —ionic solute, polar solvent, water surrounds the ions. Will oil dissolve in water? No —nonpolar solute, polar solvent (they separate).

Molecules with both parts

A molecule with a polar and a nonpolar end (like soap) can bridge the two, which is why soap cleans grease.

2 Practice

Now apply the methods above.

2.1 State the ”like dissolves like” rule. [1]

2.2 Will a nonpolar substance dissolve in water? Give a reason. [2]

2.3 Name a good solvent for an ionic compound. [1]

3 Exam-style questions

3.1 A polar solute is most soluble in [1]

- **A** a nonpolar solvent
- **B** a polar solvent
- **C** any solvent equally
- **D** no solvent

3.2 Iodine (I_2, nonpolar) is shaken with water and with hexane (nonpolar).

(a) In which solvent does it dissolve better? [1]

(b) Explain using intermolecular forces. [2]

3.3 Explain why ethanol (CH_3CH_2OH) is soluble in water but hexane is not. [2]

4 Go further

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

- work through the **3.10 Solubility** lesson on the **Learn** page;
- read the **Solubility** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 A solute dissolves in a solvent with similar intermolecular forces (polar dissolves polar, nonpolar dissolves nonpolar).

2.2 No —water is polar; it cannot form favorable attractions with a nonpolar solute, so they stay separate.

2.3 Water (a polar solvent).

3.1 B —a polar solvent.

3.2 (a) Hexane. (b) I_2 is nonpolar, so it mixes with the nonpolar hexane (similar dispersion forces) but not with polar, hydrogen-bonded water.

3.3 Ethanol has an $-OH$ group that hydrogen-bonds with water, so it dissolves; hexane is entirely nonpolar and cannot form such attractions with water.