

3.10 Solubility

Name: _____ Class: _____ Date: _____

Total: 10 marks**KEY WORDS** solubility 溶解度 • solution 溶液 • solvent 溶剂 • solute 溶质 • intermolecular forces 分子间作用力

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
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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]

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.