A11 · Intermolecular forces · Practice key

This is the worked key. Every practice question is worked step by step.

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · List the intermolecular forces of a substance

Use the three steps to list the intermolecular forces of water, H_2O. Water is a polar molecule.

1. Write London forces. Every molecule has them.
2. Add dipole-dipole forces if the molecule is polar: water is polar, so add them.
3. Add hydrogen bonding if H is on N, O or F: each hydrogen is bonded to oxygen, so add it.

Answer: Water has London forces, dipole-dipole forces and hydrogen bonding.

Example 2 · Compare London forces by counting electrons

Methane is CH_4 and ethane is C_2H_6. Both are non-polar. Which has stronger London forces?

1. Count the electrons in one molecule: add the atomic numbers of its atoms.
2. CH_4 has 6 + 4 = 10 electrons.
3. C_2H_6 has 12 + 6 = 18 electrons.
4. More electrons give stronger London forces.

Answer: Ethane has stronger London forces.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. Which intermolecular force does every molecule have?

1. Every molecule has London forces.
2. A non-polar molecule has them too.

EASY

2. How many electrons are in one molecule of water, H_2O? Show your count.

1. Add the atomic numbers: hydrogen is 1 and oxygen is 8.
2. 1 + 1 + 8 = 10 electrons.

EASY

3. Is a covalent bond an intermolecular force? Explain.

1. No. A covalent bond holds the atoms of one molecule together.
2. It is an intramolecular force. Intermolecular forces act between molecules.

EASY

4. For hydrogen bonding, a hydrogen atom must be bonded to one of three kinds of atom. Name them.

1. Nitrogen, oxygen or fluorine.
2. A hydrogen atom bonded to carbon does not count.

MEDIUM

5. O_2 and N_2 are both non-polar. Count the electrons in one molecule of each. Which has stronger London forces?

1. O_2 has 8 + 8 = 16 electrons.
2. N_2 has 7 + 7 = 14 electrons.
3. O_2 has more electrons, so its London forces are stronger.

MEDIUM

6. Name the intermolecular forces of hydrogen bromide, HBr. It is a polar molecule.

1. Every molecule has London forces.
2. HBr is polar, so add dipole-dipole forces.
3. Hydrogen is bonded to Br, not to N, O or F. So HBr has no hydrogen bonding.

MEDIUM

7. Name the intermolecular forces of methanol, CH_3OH. It is a polar molecule, and one hydrogen is bonded to oxygen.

1. Every molecule has London forces.
2. Methanol is polar, so add dipole-dipole forces.
3. A hydrogen is bonded to oxygen, so add hydrogen bonding.

MEDIUM

8. Name the intermolecular forces of methane, CH_4. It is a non-polar molecule.

1. Every molecule has London forces.
2. CH_4 is non-polar, so it has no dipole-dipole forces.
3. Every hydrogen is bonded to carbon, so it has no hydrogen bonding.

HARDER

9. Formaldehyde, CH_2O, is a polar molecule. Both hydrogen atoms are bonded to carbon. Name its intermolecular forces. Then explain why it has no hydrogen bonding, even though it has an oxygen atom.

1. It has London forces, and dipole-dipole forces because it is polar.
2. Hydrogen bonding needs a hydrogen atom bonded to N, O or F.
3. Both hydrogen atoms are bonded to carbon, and that does not count.

HARDER

10. One molecule of hydrogen fluoride, HF, has 10 electrons. One atom of neon has 10. So their London forces are about equal. Name the other forces HF has. Then say which substance has the stronger attractions between its particles.

1. HF is polar, so it has dipole-dipole forces.
2. Its hydrogen is bonded to F, so it also has hydrogen bonding.
3. Neon has London forces only. So HF has the stronger attractions.