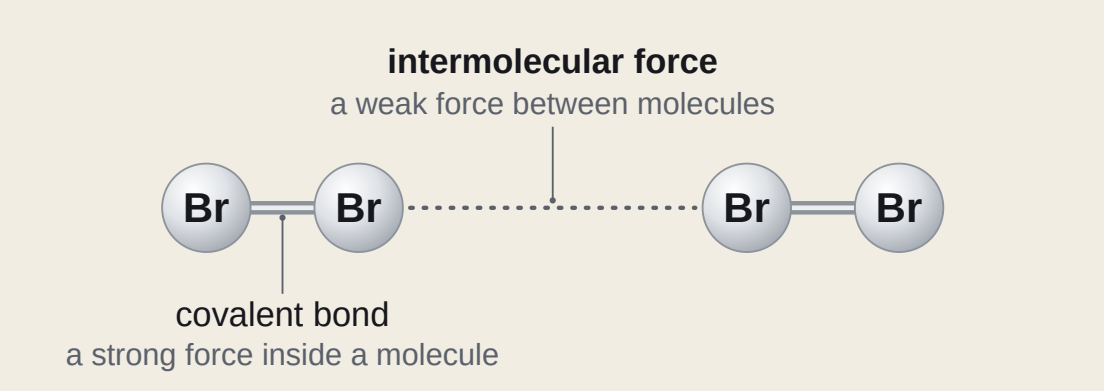
A11 · Intermolecular forces · Notes

Goals: Explain the difference between a bond inside a molecule and a force between molecules. Describe London forces, dipole-dipole forces and hydrogen bonding. List the intermolecular forces of a substance from its formula and structure.

Name: _____ Date: _____

Slide 1 of 6 · Forces between molecules

In lessons A5 to A10 you studied the bonds inside one molecule. Bonds hold a molecule together. Something else holds molecules near each other.



Key ideas

A bond inside a substance is an _____.

An _____ is an attraction between one molecule and the next.

Intermolecular forces are much _____ than bonds.

Example

Liquid water is made of H_2O molecules. Name the force inside one molecule and the force between molecules.

Try it

Which is stronger, a covalent bond or an intermolecular force?

Slide 2 of 6 · London forces

The last slide said molecules attract each other. Start with the weakest attraction. Even a non-polar molecule has it.



for an instant, the electrons are more on one side

Molecule	Count	Electrons
Cl_2	2 × 17	34
Br_2	2 × 35	70
I_2	2 × 53	106

stronger London forces

electrons in a molecule = the sum of its atomic numbers

Key ideas

Every molecule has _____.

More _____ give stronger London forces.

To count the electrons, add the _____ of the atoms.

Br_2 has _____ electrons.

Example

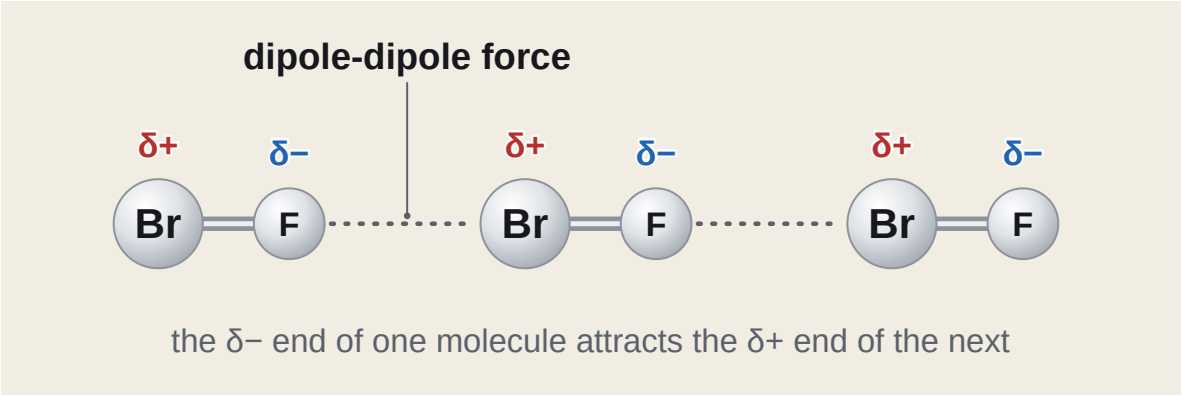
How many electrons are in one molecule of fluorine, F_2? Show your count.

Try it

Methane is CH_4 and propane is C_3H_8. Which has stronger London forces? Show your counts.

Slide 3 of 6 · Dipole-dipole forces

On the last slide, a molecule had a δ− side for an instant. A polar molecule has a negative side and a positive side all the time.



the δ− end of one molecule attracts the δ+ end of the next

Key ideas

The δ− side of one molecule attracts the _____ of the next.

This attraction is a _____.

Only _____ have dipole-dipole forces.

Example

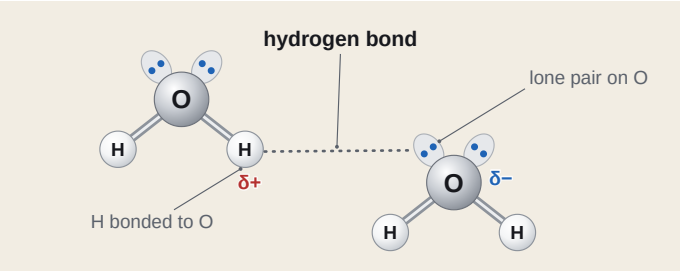
HCl is a polar molecule. Does it have dipole-dipole forces? Say why.

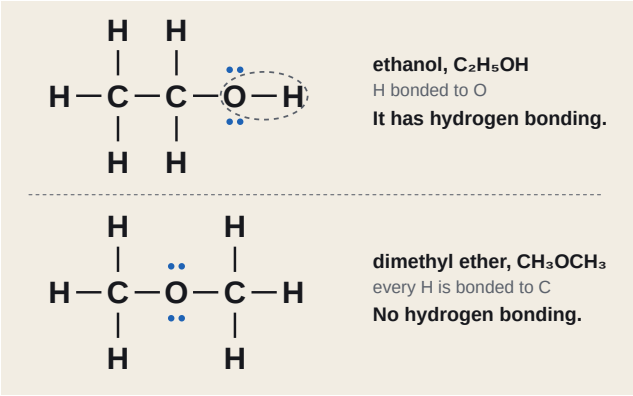
Try it

CO_2 is a non-polar molecule. Does it have dipole-dipole forces? Say why.

Slide 4 of 6 · Hydrogen bonding

On the last slide, polar molecules attracted each other. One kind of polar bond gives an attraction strong enough to have its own name.





Key ideas

_____ needs a hydrogen atom bonded to N, O or F.

It also needs a _____ on N, O or F in the next molecule.

A hydrogen atom bonded to _____ does not count.

Example

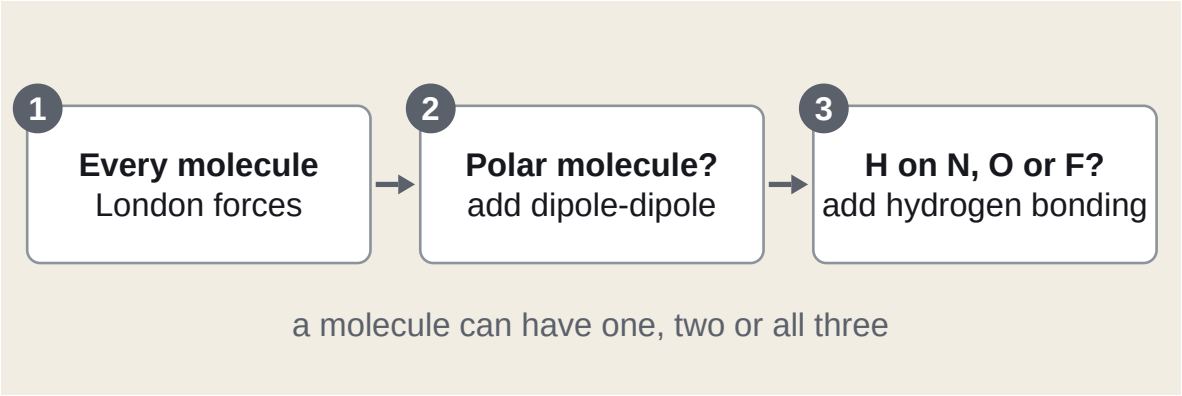
Does ammonia, NH_3, have hydrogen bonding? Say why.

Try it

Does methane, CH_4, have hydrogen bonding? Say why.

Slide 5 of 6 · List the forces

You have now met three intermolecular forces: London forces, dipole-dipole forces and hydrogen bonding. Three questions find which ones a substance has.



Key ideas

Every molecule has _____.

If the molecule is _____, add dipole-dipole forces.

If a hydrogen is bonded to N, O or F, add _____.

Example

Name the intermolecular forces of hydrogen fluoride, HF.

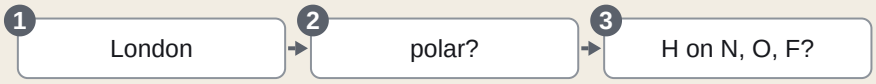
Try it

Name the intermolecular forces of carbon tetrachloride, CCl_4.

Slide 6 of 6 · Method: how to list the intermolecular forces of a substance

You just listed the forces of three substances. Each time you asked the same three questions. Here they are as steps.

1. **Write** London forces. Every molecule has them.
2. **Add** dipole-dipole forces if the molecule is polar.
3. **Add** hydrogen bonding if H is on N, O or F.



Check: H bonded to carbon does not count.

Used again in: lesson A12

Key ideas

Step 1: write _____ forces.

Step 2: ask if the molecule is _____.

Step 3: look for a _____ bonded to N, O or F.

Example

Use the three steps on ammonia, NH_3.

Try it

Use the three steps on hydrogen chloride, HCl.