A6 · Double and triple bonds · Notes

Goals: Explain why two atoms share a second or a third pair of electrons. Draw electron dot diagrams and structural formulas for molecules with double and triple bonds. Draw molecules with two middle atoms, and check every atom.

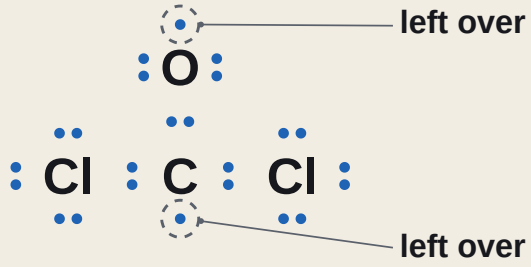
Name: _____ Date: _____

Slide 1 of 6 · When single dots are left over: the double bond

In lesson A5, every molecule was drawn with single bonds. In some molecules, single bonds leave dots unshared. Today you see what the atoms do with those dots.

with single bonds only

C has 7. O has 7.



Key ideas

Left-over dots on joined atoms are shared as a _____.

Two shared pairs between the same two atoms are a _____.

In the structural formula, a double bond is _____ dashes.

Example

Formaldehyde is CH_2O. Carbon is the middle atom. After single bonds, which atoms have a dot left over? What do they do?

Try it

In $COCl_2$, how many electrons are around the carbon atom? Show your count.

Slide 2 of 6 · The triple bond

On the last slide, carbon and oxygen shared two pairs. Two atoms can share three pairs too.

with single bonds only



C has 2 left over N has 2 left over

Key ideas

Three shared pairs between the same two atoms are a _____.

In the structural formula, a triple bond is _____ dashes.

In HCN, nitrogen has 8 electrons, with _____ lone pair.

Example

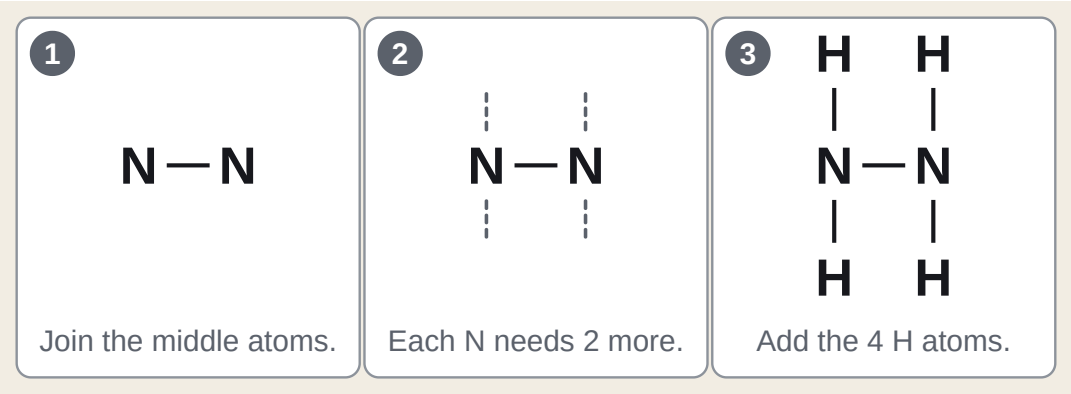
Nitrogen gas is N_2. Each nitrogen atom forms 3 bonds. What kind of bond joins the two atoms?

Try it

In the structural formula of HCN, how many dashes join C and N? How many join H and C?

Slide 3 of 6 · Molecules with two middle atoms

So far each molecule had one middle atom. Some molecules have two atoms that each form more than one bond. Both are middle atoms.



Key ideas

Step 1: join the two _____ first.

Step 2: _____ the dashes each middle atom still needs.

Step 3: add the _____.

Example

Hydrogen peroxide is H_2O_2. Each oxygen forms 2 bonds. Use the three steps to find its structural formula.

Try it

Ethane is C_2H_6. Each carbon forms 4 bonds. Use the three steps to find its structural formula.

Slide 4 of 6 · Multiple bonds between different atoms

On the last slide, the double bond joined two carbon atoms. The same steps work when the two joined atoms are different elements.

nitrosyl chloride, NOCl



electron dot diagram | structural formula

Key ideas

In NOCl, nitrogen forms 3 bonds, oxygen 2 and chlorine _____.

So _____ is the middle atom.

NOCl has 1 single bond and 1 _____.

Example

Carbon dioxide is CO_2. Carbon forms 4 bonds and each oxygen forms 2. What bonds join the atoms?

Try it

In CS_2, what kind of bond joins carbon to each sulfur atom? Say why.

Slide 5 of 6 · Method: how to place double and triple bonds

You have now placed double bonds and a triple bond. Each time you did the same four things. Here they are as steps.

1. **Join** the atoms with single bonds.
2. **Find** atoms with single dots left over.
3. **Pair** left-over dots of two joined atoms.
4. **Count** the electrons around each atom.



Check: every atom has 8. Hydrogen has 2.

Used again in: lessons A8 and A9

Key ideas

Step 1: join the atoms with _____.

Step 2: find the dots that are _____.

Step 3: _____ the left-over dots again.

Step 4: _____ the electrons at every atom.

Example

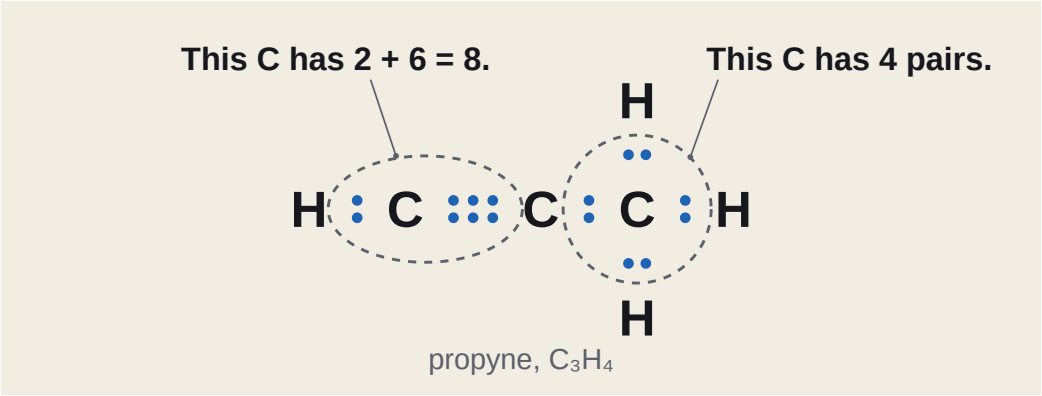
Use the four steps on oxygen gas, O_2. Each oxygen atom forms 2 bonds.

Try it

Use the four steps on ethyne, C_2H_2. Each carbon atom forms 4 bonds.

Slide 6 of 6 · Check and draw

In lesson A5, the last step was to check every atom for 8 electrons. A double or triple bond changes how you count. It also changes how you draw.



propyne, C_3H_4

Key ideas

A double bond counts as _____ electrons.

A triple bond counts as _____.

Draw the dashes of a double or triple bond _____.

Example

In HCN, how many electrons are around the carbon atom? Show your count.

Try it

In $COCl_2$, how many electrons are around the oxygen atom? Show your count.