4.3 Covalent Structures

Bond length and strength

	Bond length	Bond strength
single bonds	longest	weakest
double bonds	intermediate	intermediate
triple bonds	shortest	strongest

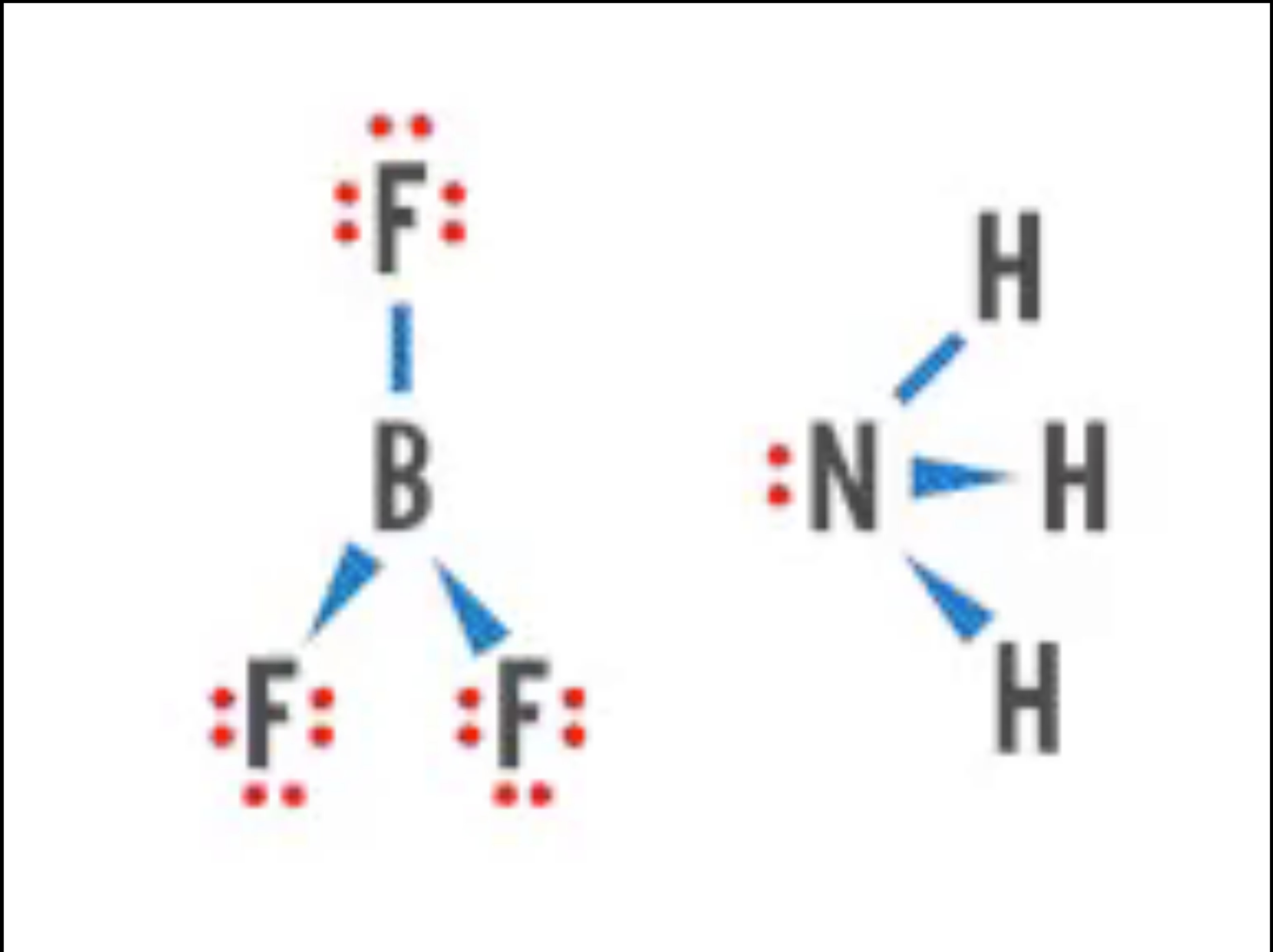
Lewis Structures for Ozone

Resonance Structures:

A molecule or polyatomic ion that cannot be represented by a single Lewis structure.

(All will contain a double bond that can be placed on more than one atom)

Dative (coordinate) covalent bond: When one atom supplies both electrons in a covalent bond.



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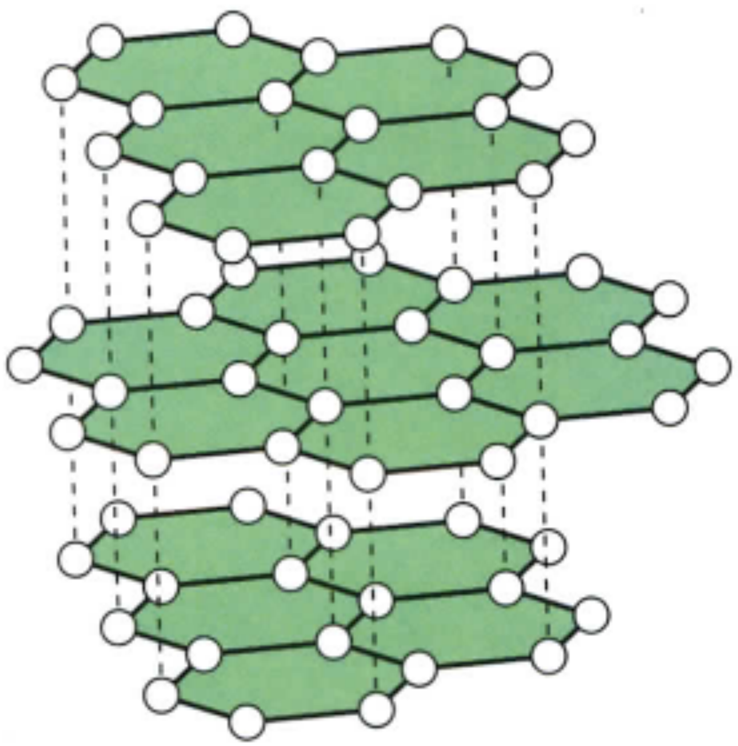
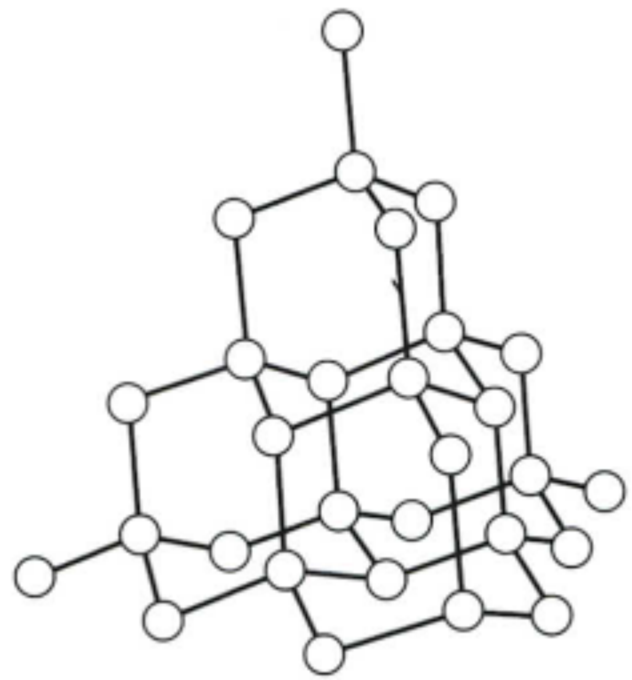
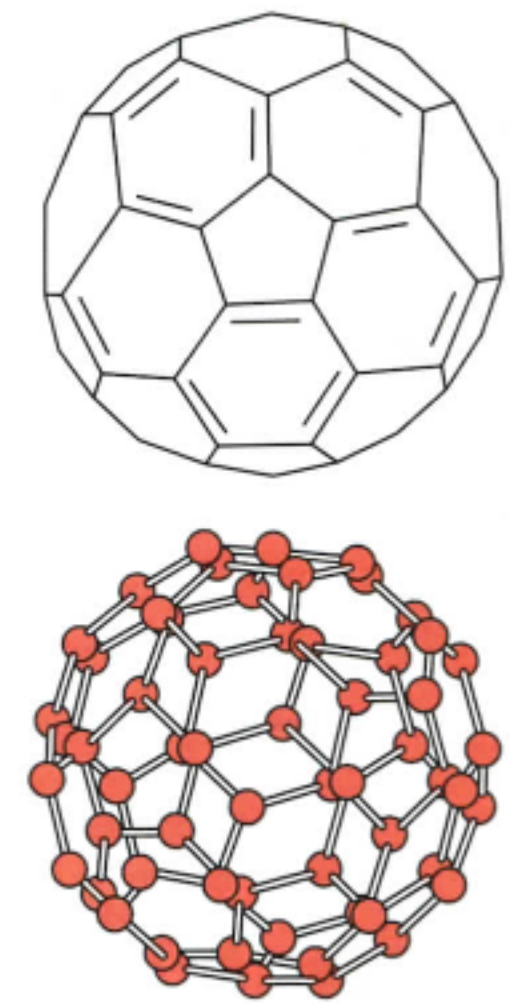
Large covalent structures: carbon, silicon, and silicon dioxide.

IB CHEMISTRY VIDEO REVIEW COMPLETE

Carbon can exist as 3 separate allotropes*:

*Two or more different physical forms in which an element can exist.

Graphite	Diamond	Fullerene C_{60}
		

Carbon can exist as 3 separate allotropes:

-Graphite: planer, each atom is covalently bonded to 3 others (has resonance).

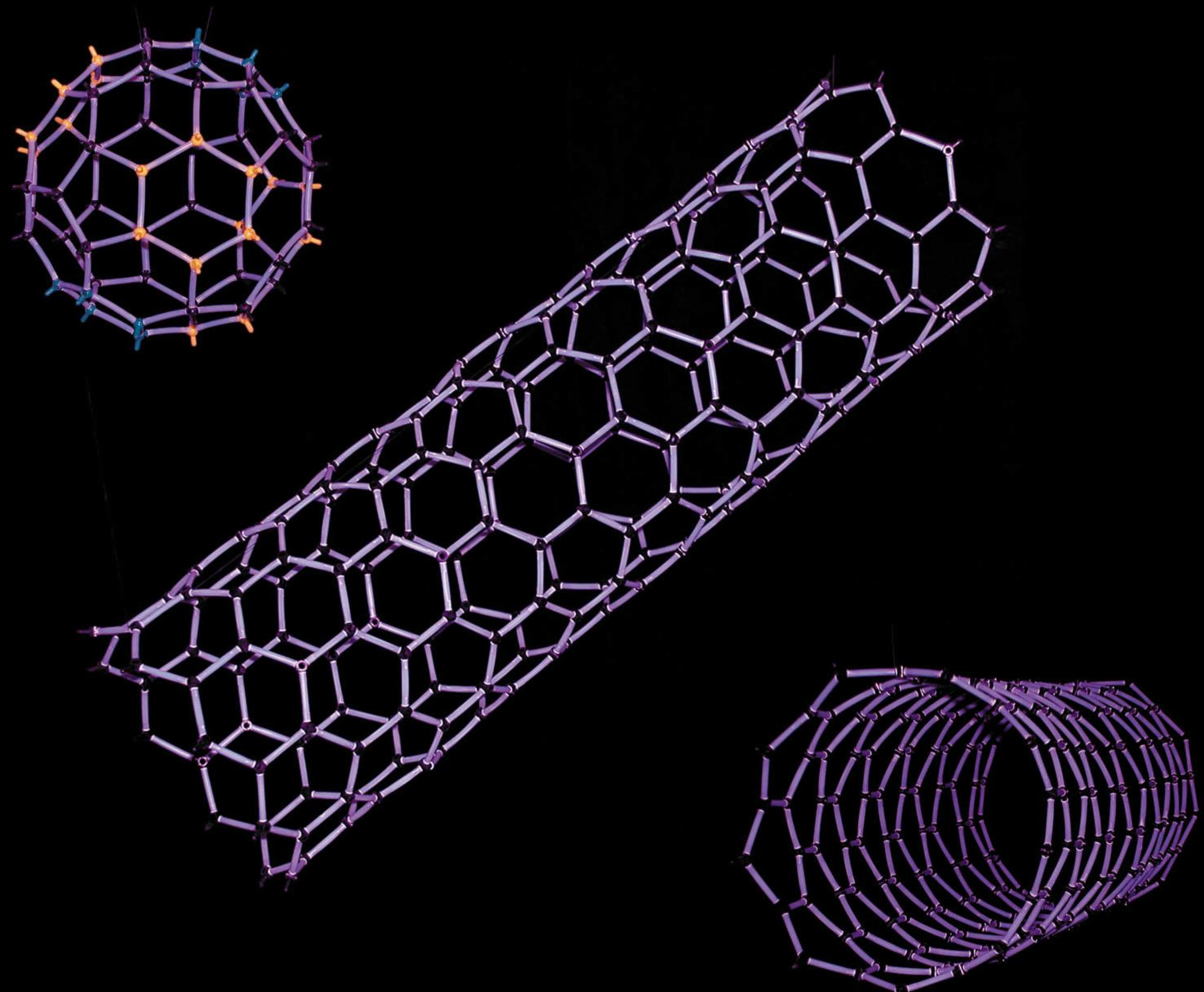
-Diamond, each atom is covalently bonded to 4 others.

-Fullerene, each atom is covalently bonded within a sphere of 60 atoms.

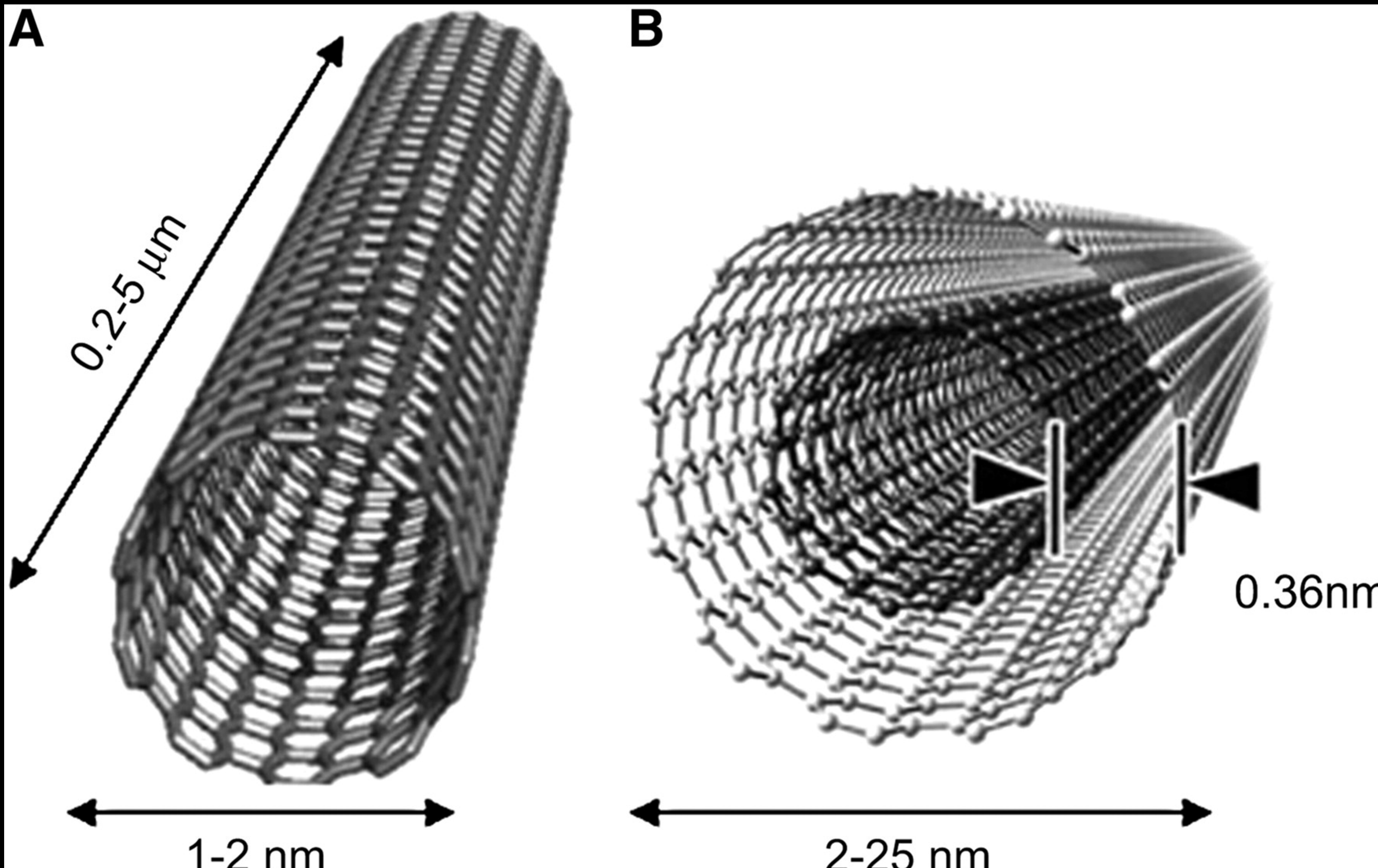
Summary:

	Graphite	Diamonds	Fullerene
Bonding:	trigonal planar	tetrahedral	60-atom sphere
Structure:	parallel layers that slide over one another (held together only by weak dispersion	large network solid (hardest known natural substance)	closed sphere with each carbon atom bonded to three others.
Resonance	Yes	No	Yes
Electrical conductivity:	Yes	No	Yes
Uses:	pencils; lubricant	jewelry; cutting tools	superconducting material; nanotubes

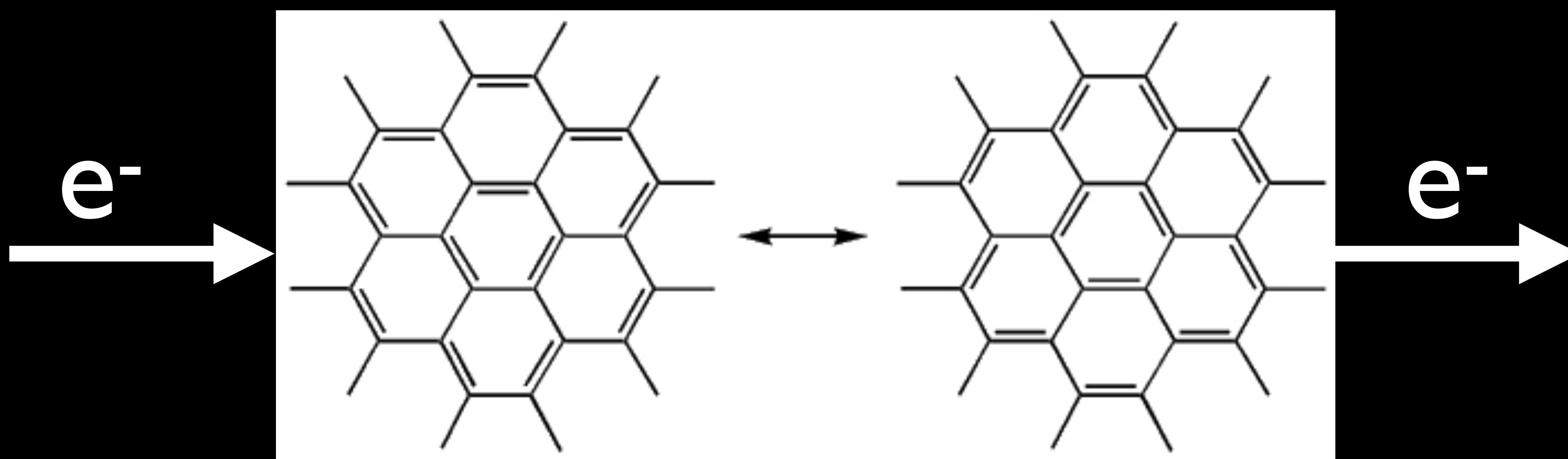
Nanotubes:



Nanotubes:



Due to the resonance of the benzene rings, graphite is easily able to conduct electricity.



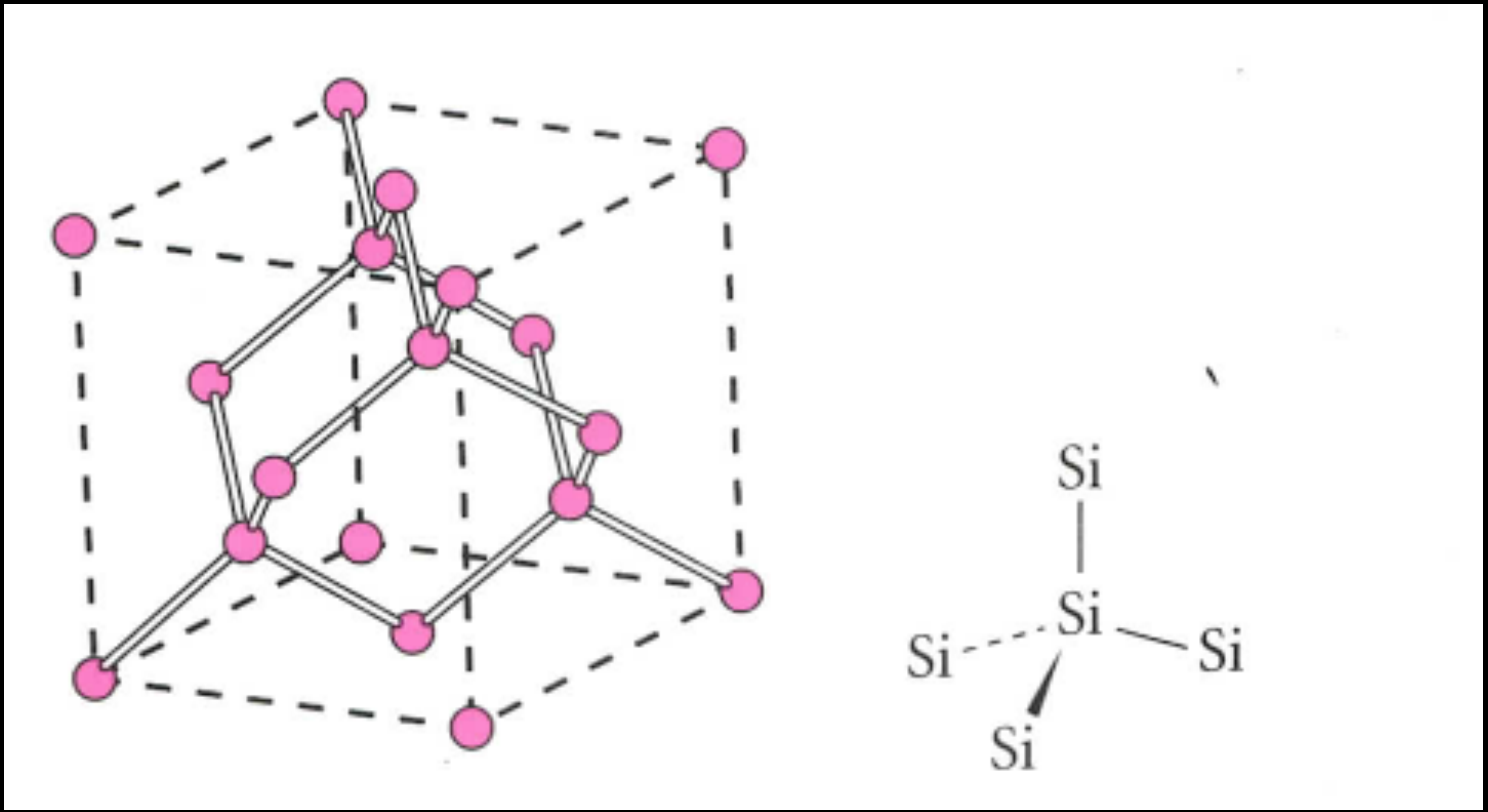
graphite

Silicon:

-Tetrahedral bonding, similar to a diamond although its bonds are much weaker.

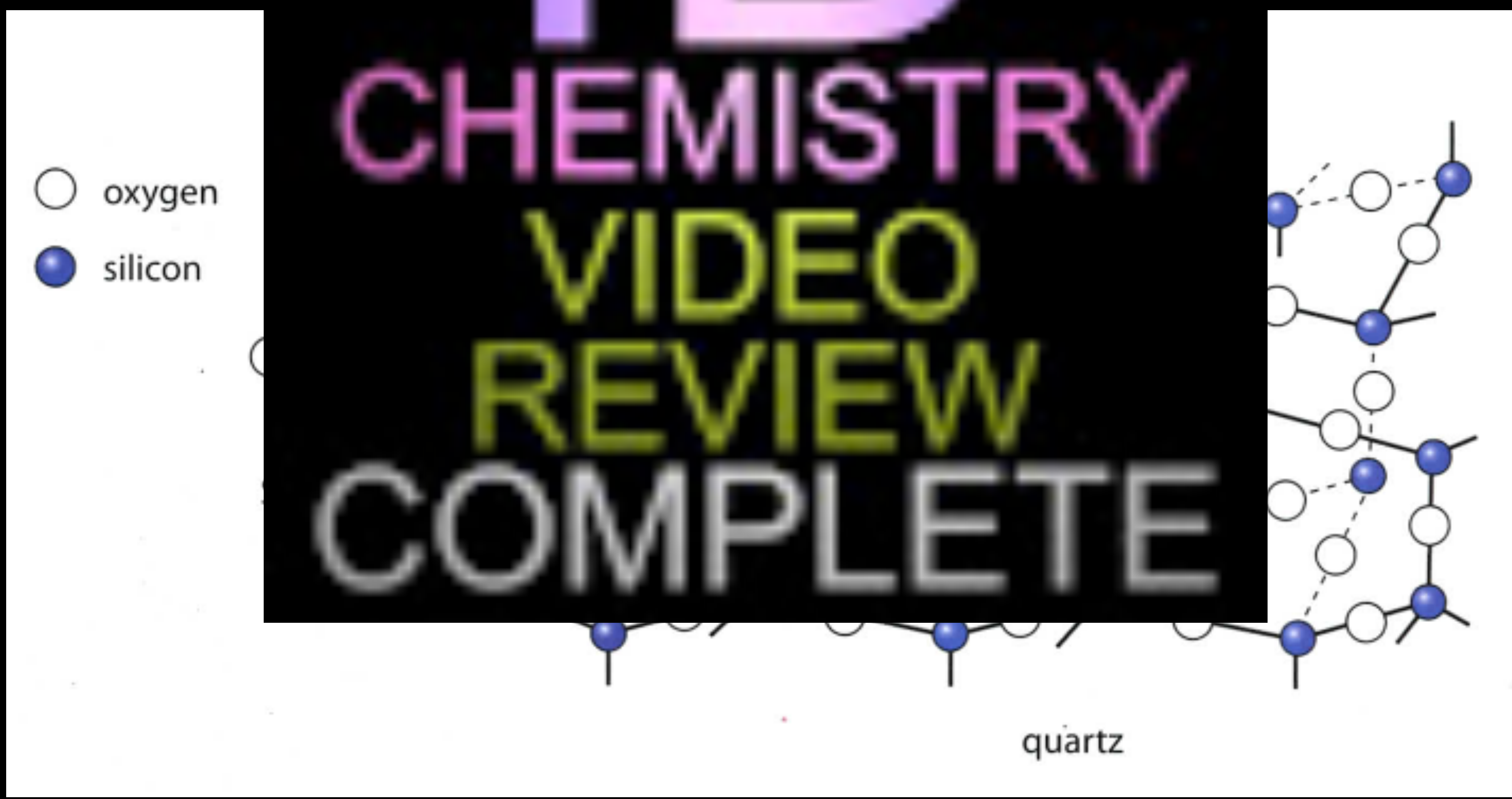
- Results in a giant covalent lattice.

(aka: macromolecule or a network solid)



Silicon dioxide (quartz):

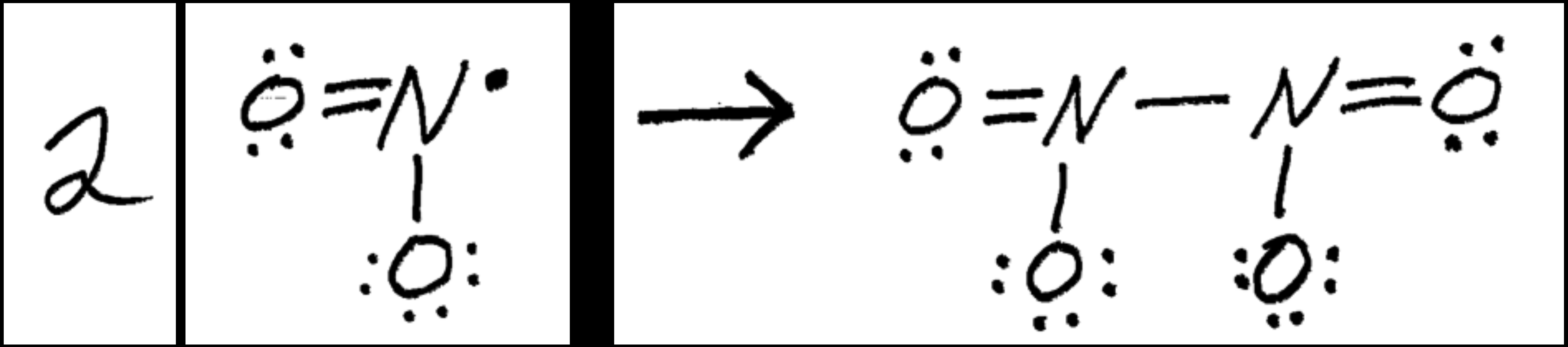
-Tetrahedral bonding, with each silicon atom bonded t… and each oxygen at… n atoms.
- Forms a … olid.



Dimerization:

When two identical molecules combine in order to form more stable octets.

Example: NO_2 will become N_2O_4



The VSEPR model

(<u>v</u>alence <u>s</u>hell <u>e</u>lectron <u>p</u>air <u>r</u>epulsion)

Use to predict molecular:

- shape
- bond angles
- polarity

To determine molecular shape, count the total number of "electron domains."

An electron domain is any pairing of electrons:

single bonds (-)

triple bonds ($\equiv$)

double bonds (=)

lone pairs (· ·)

repel most of all!!!

All electron domains will arrange around a central atom <u>as</u> <u>far</u> <u>apart</u> <u>as</u> <u>possible</u>.

(see summary handout)

Molecular Polarity

Nonpolar molecules are symmetrical with all bond polarities canceling each other.

Polar molecules are asymmetrical (non symmetrical) and will have the overall (net) bond dipoles directed towards one side of the molecule.

A molecule will always be polar if the central atom:

- has a lone pair
- is bonded to different atoms