Bio-informatica

Chemie H4

Course 1

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Vandaag

Uitleg H4.1 t/m 4.5
Maken opdrachten
Nabespreken

Hoofdstuk 4; Molecular Compounds

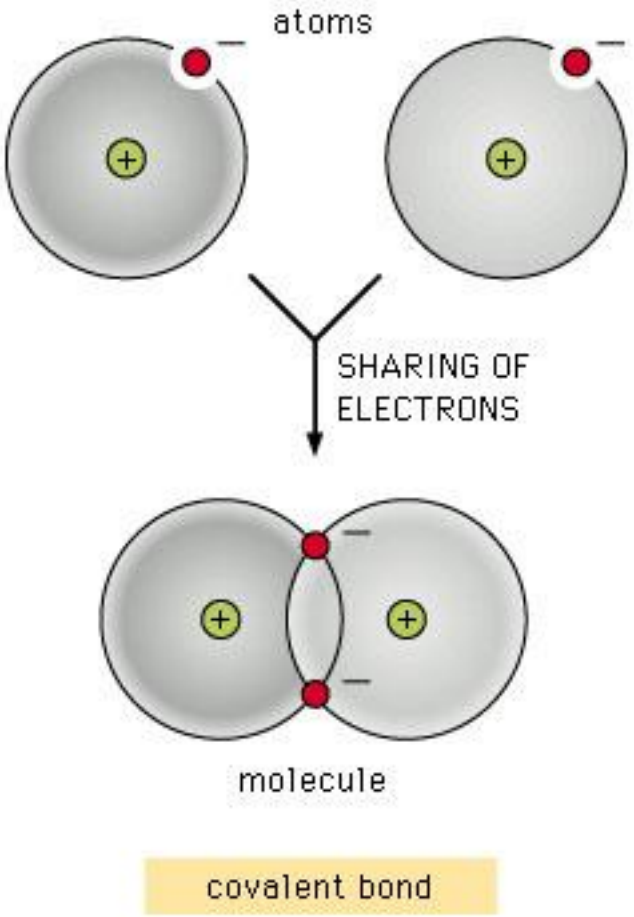
- Wat is een covalente binding?
- Hoe kan de octet regel worden toegepast op covalente bindingen?
- Wat zijn de verschillen tussen ionische en covalente bindingen?

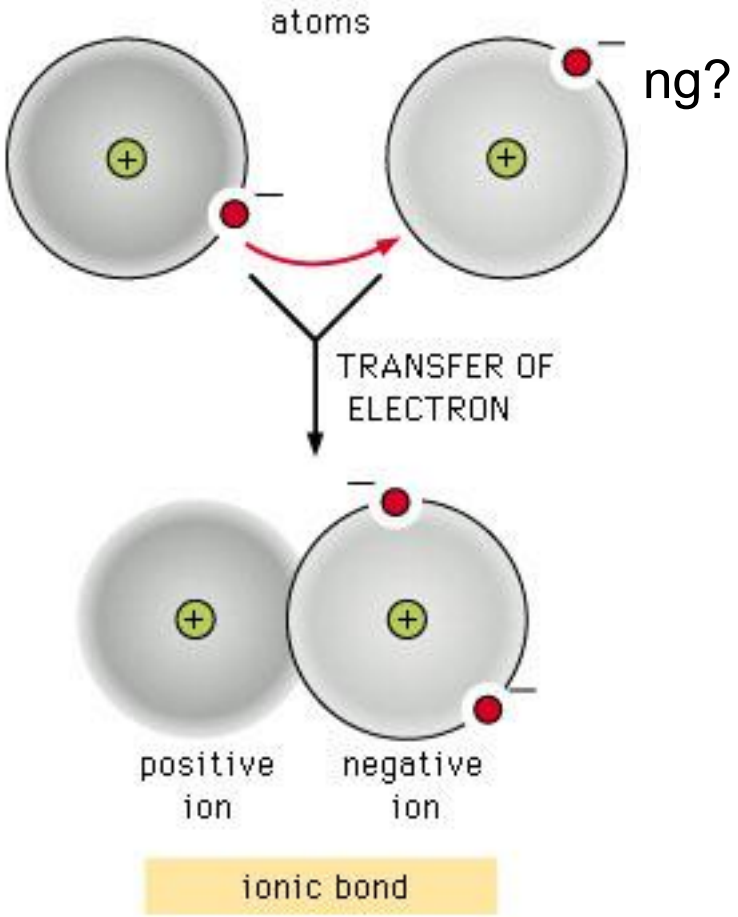
4.1 Covalent Bonds

Wat is het verschil tussen een ionbinding en een covalente binding?

4.1 Covalent Bonds

Wat





ng?

4.1 Covalent Bonds

- Wat is het verschil tussen een ionbinding en een covalente binding?

- Bij een ionbinding worden elektronen volledig overgebracht van het ene atoom naar het andere.

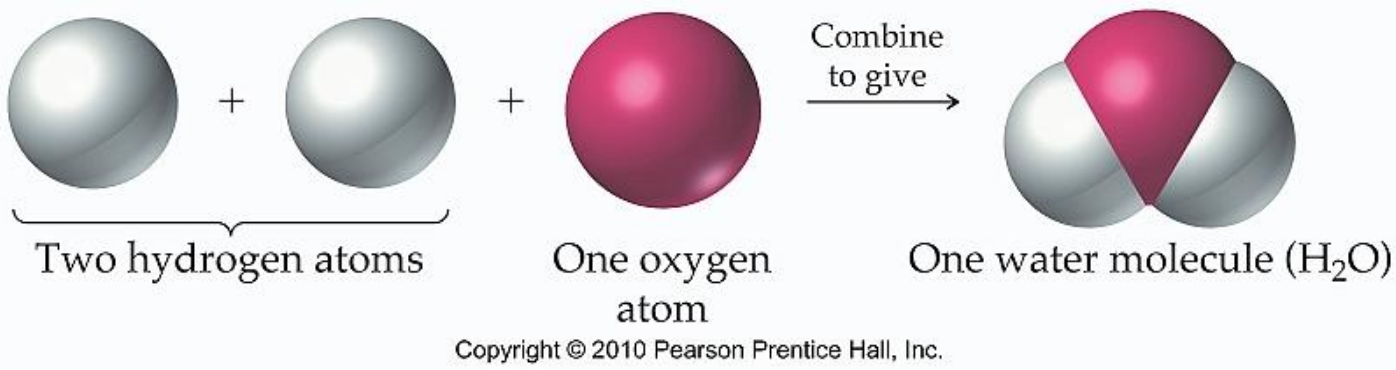
- Bij een covalente binding worden elektronen gedeeld tussen twee atomen.

4.1 Covalent Bonds

Hoe noemen we een groep atomen die bij elkaar gehouden worden door covalente bindingen?

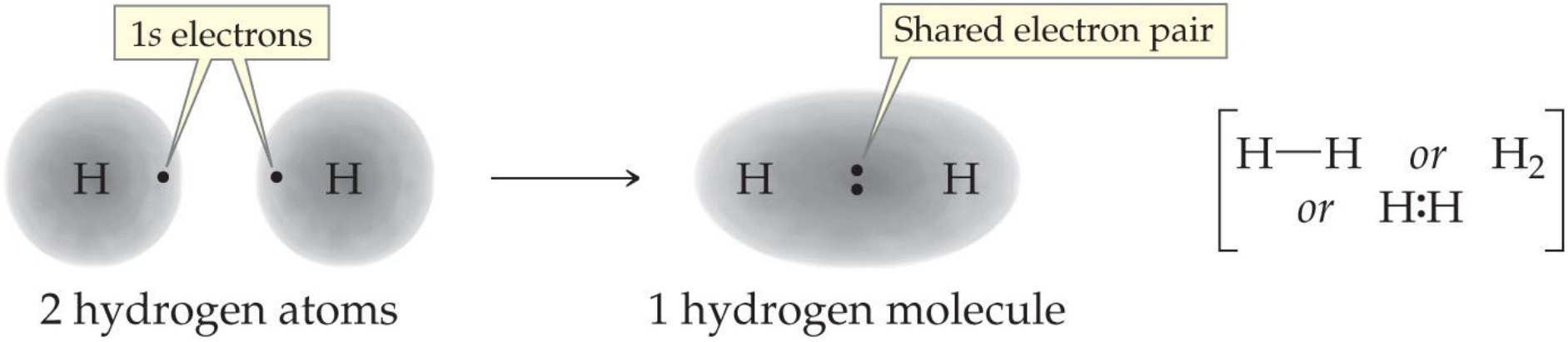
4.1 Covalent Bonds

Een groep atomen die bij elkaar worden gehouden door covalente bindingen noemen we **moleculen**.



4.1 Covalent Bonds

Atomen streven naar een edelgasconfiguratie.



4.1 Covalent Bonds

Een voorbeeld

Chlooratoom (atoomnummer =17)

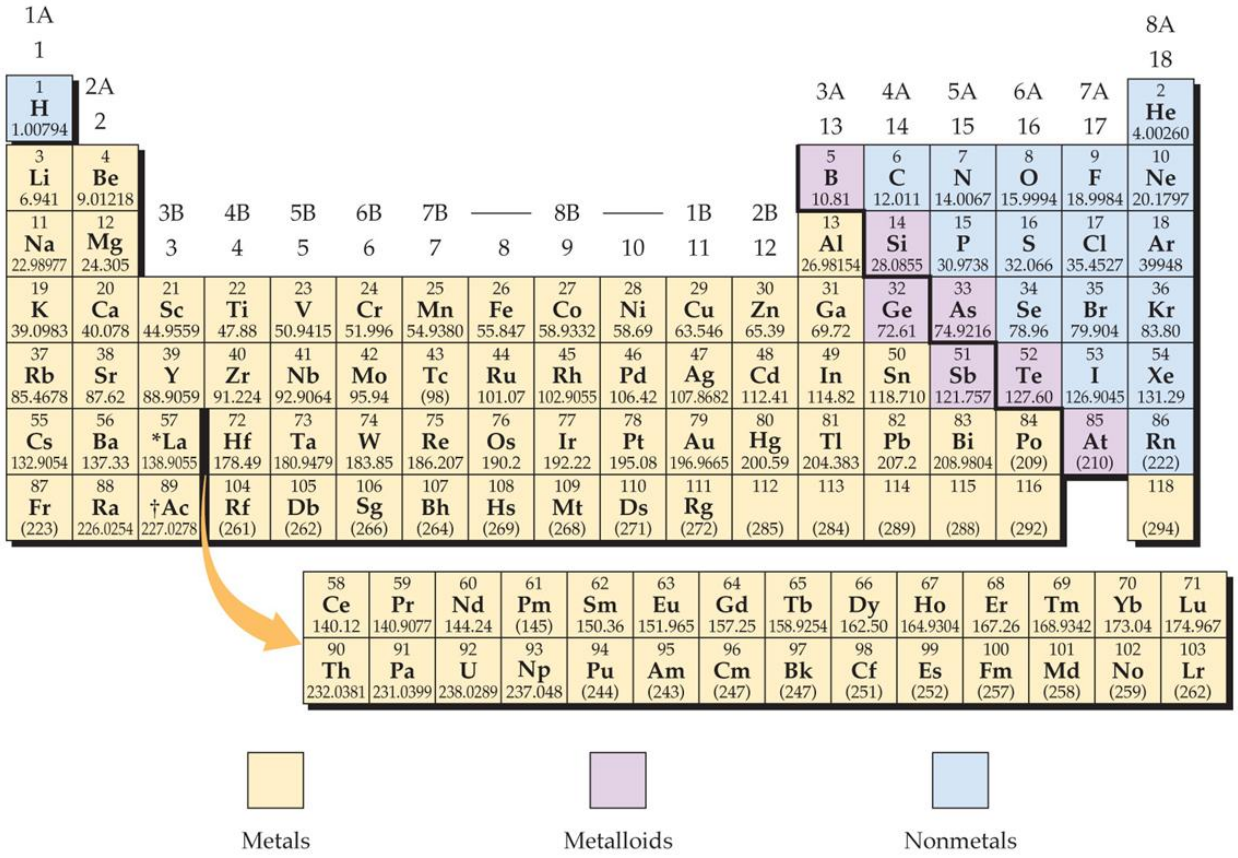
$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^5$

Dus in schil 3 bevinden zich 7 elektronen.

Om deze schil vol te krijgen (8 elektronen) deelt het chlooratoom graag 1 elektron van een ander atoom.

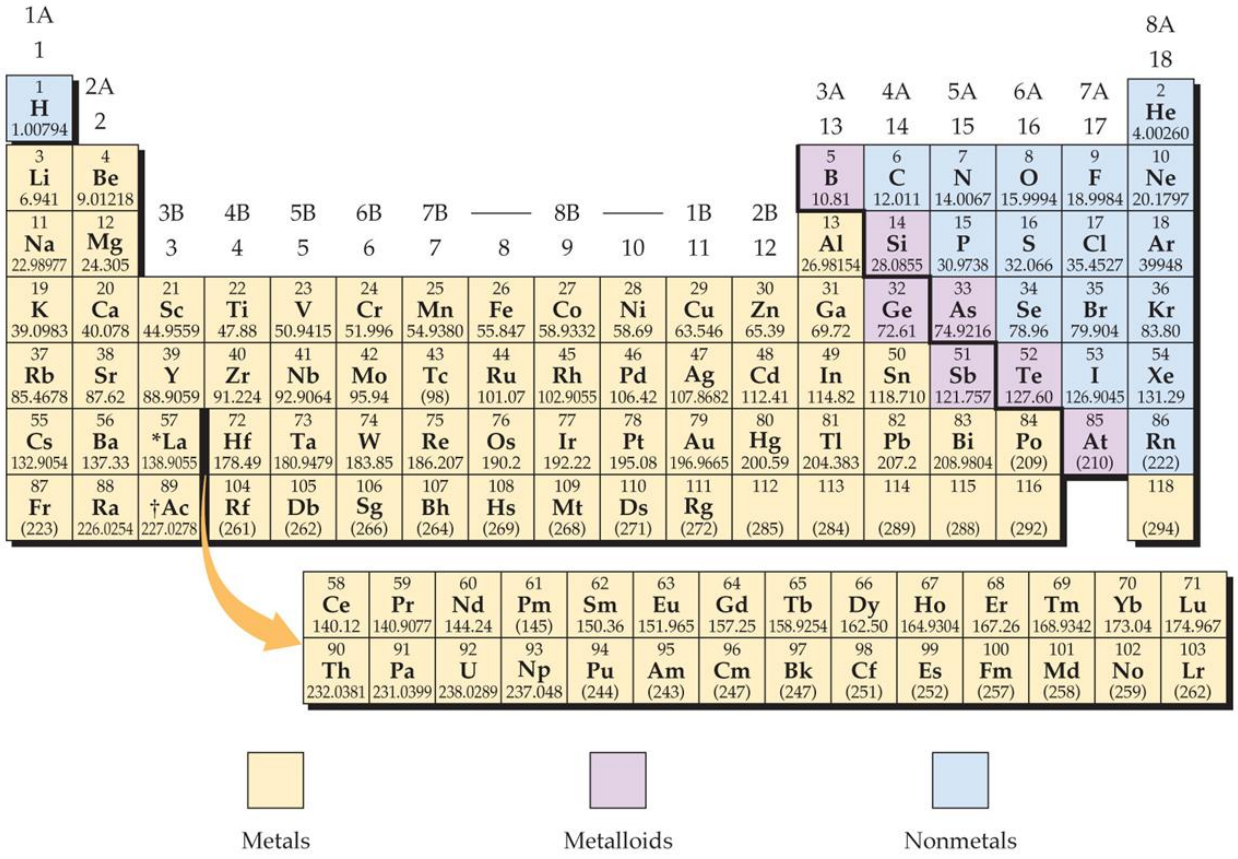
4.2 Covalent Bonds and the Periodic Table

Hoeveel covalente bindingen kan een koolstofatoom maximaal aangaan?



4.2 Covalent Bonds and the Periodic Table

En zuurstof?



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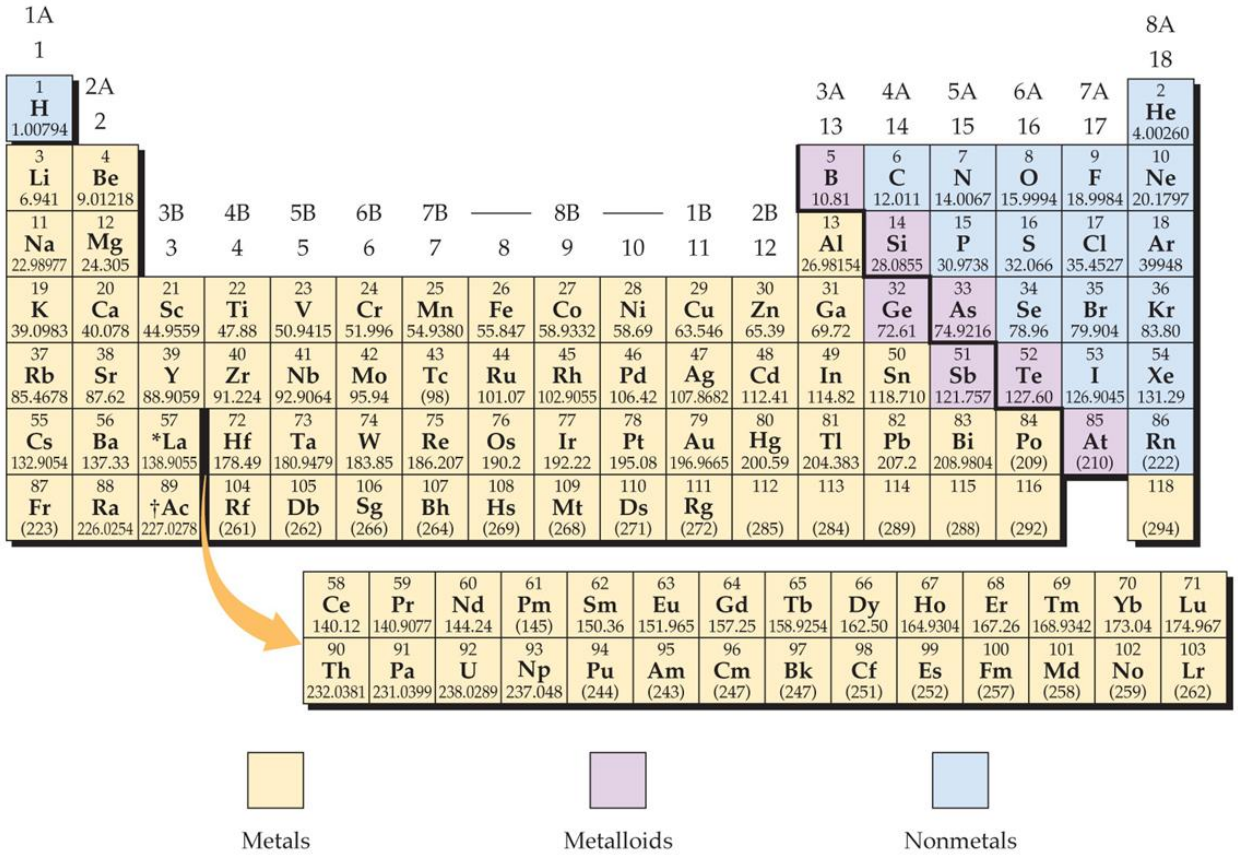
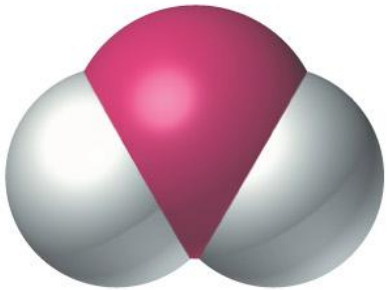
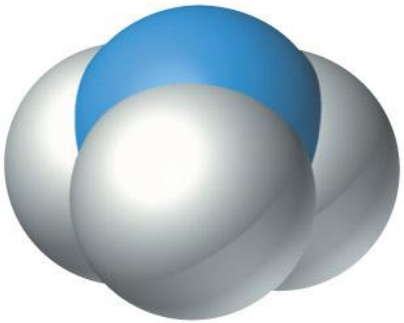
4.2 Covalent Bonds and the Periodic Table

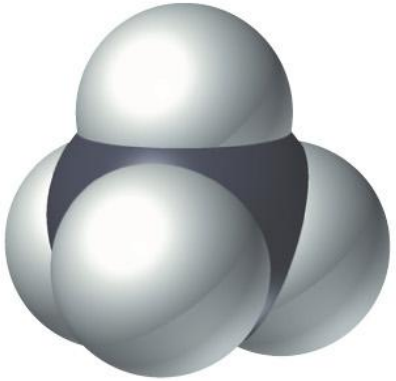
En waterstof?



4.2 Covalent Bonds and the Periodic Table

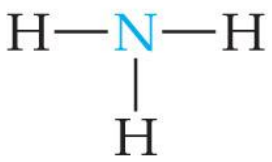






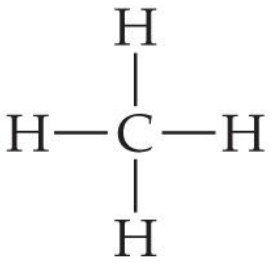
Water, H_2O

Oxygen bonds to 2 hydrogen atoms.



Ammonia, NH_3

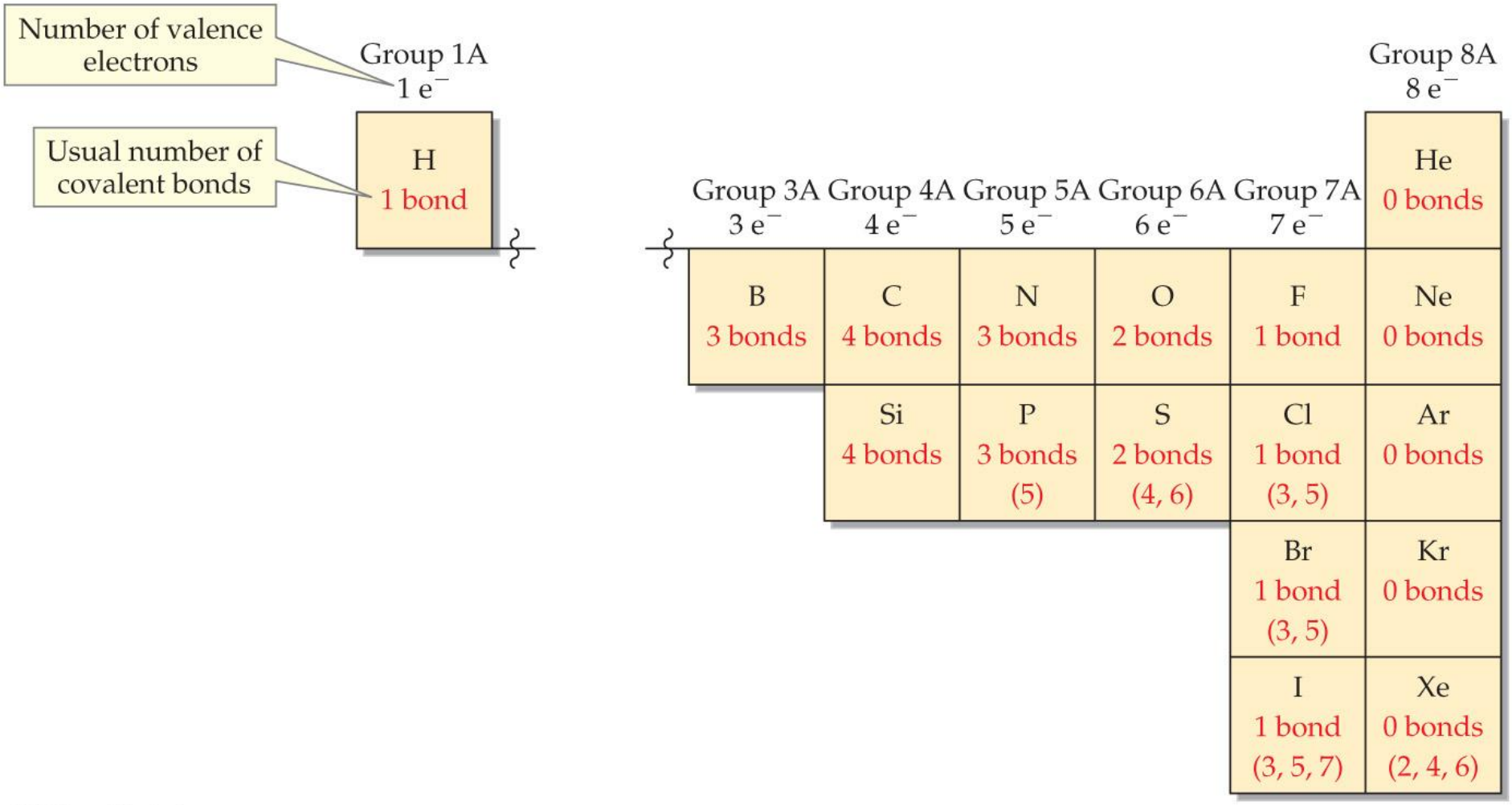
Nitrogen bonds to 3 hydrogen atoms.



Methane, CH_4

Carbon bonds to 4 hydrogen atoms.

4.2 Covalent Bonds and the Periodic Table



4.2 Covalent Bonds and the Periodic Table

Er bestaan uitzonderingen.

Bv Boron (atoomnummer 5) kan maar drie covalente bindingen aangaan.

4.2 Covalent Bonds and the Periodic Table

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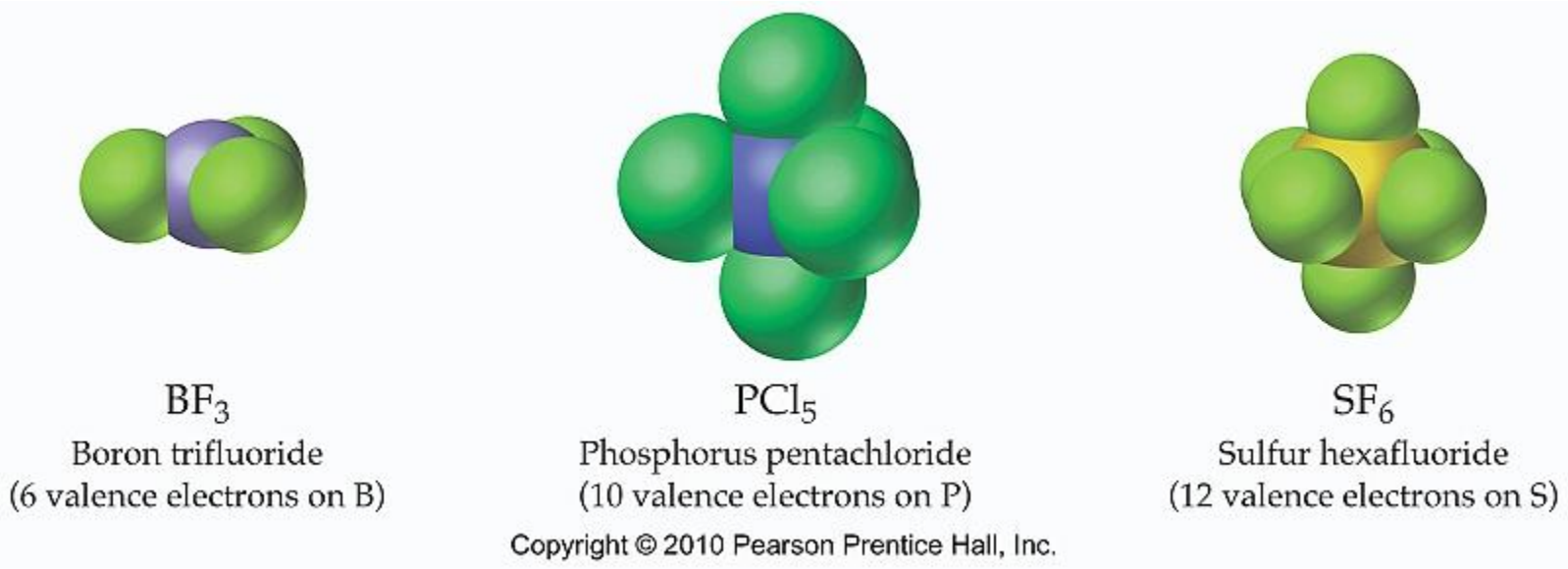
Bv Boron (atoomnummer 5) kan maar drie covalente bindingen aangaan.



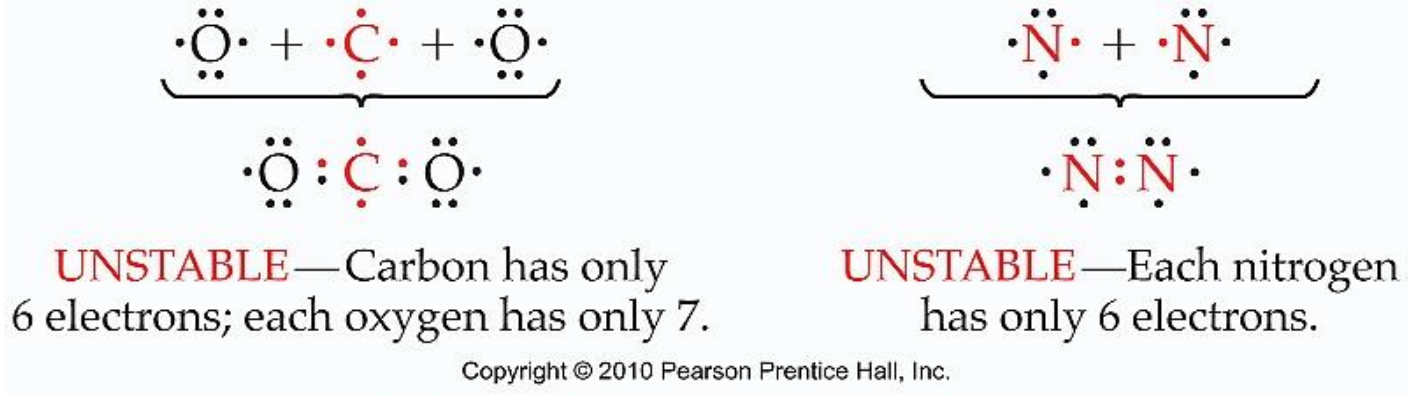
BF_3
Boron trifluoride
(6 valence electrons on B)

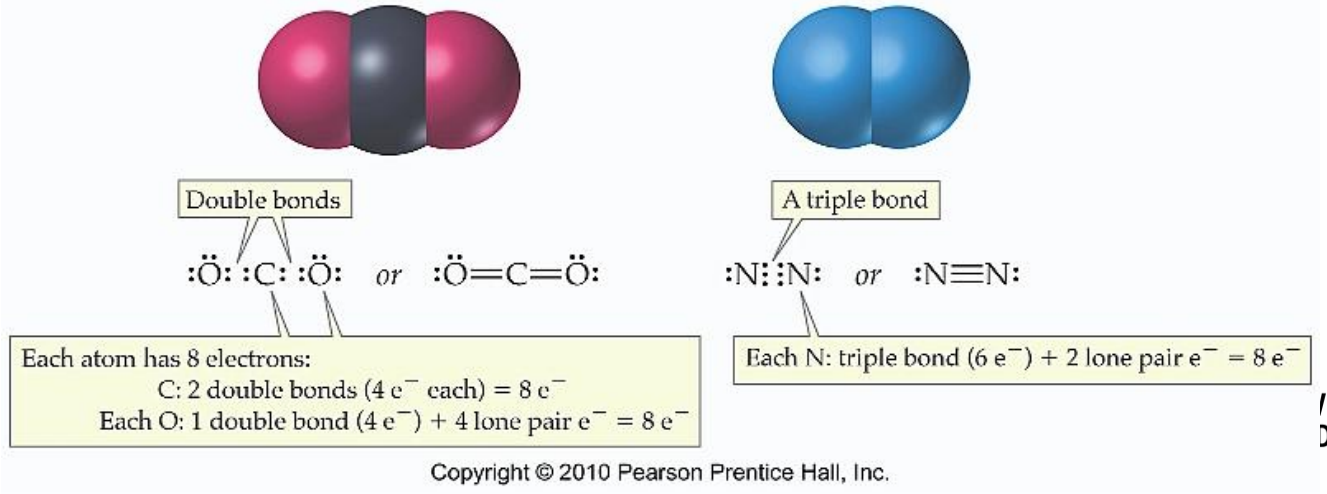
PCl_5
Phosphorus pentachloride
(10 valence electrons on P)

SF_6
Sulfur hexafluoride
(12 valence electrons on S)

4.3 Multiple covalent bonds

Het komt voor dat tussen atomen meer dan één elektron wordt gedeeld.

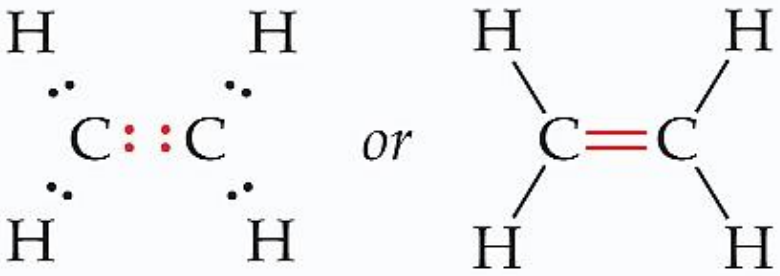




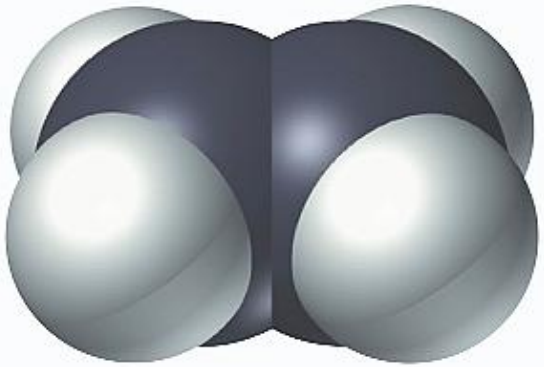
4.3 Multiple covalent bonds

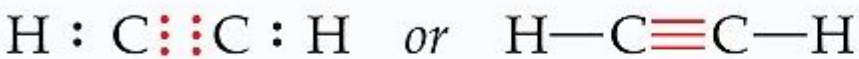
- Teken met elektronenstippen de moleculen:
  - Ethyleen (C_2H_4)
  - Acetylene (C_2H_2)

4.3 Multiple covalent bonds



Ethylene—the carbon atoms share 4 electrons in a double bond.





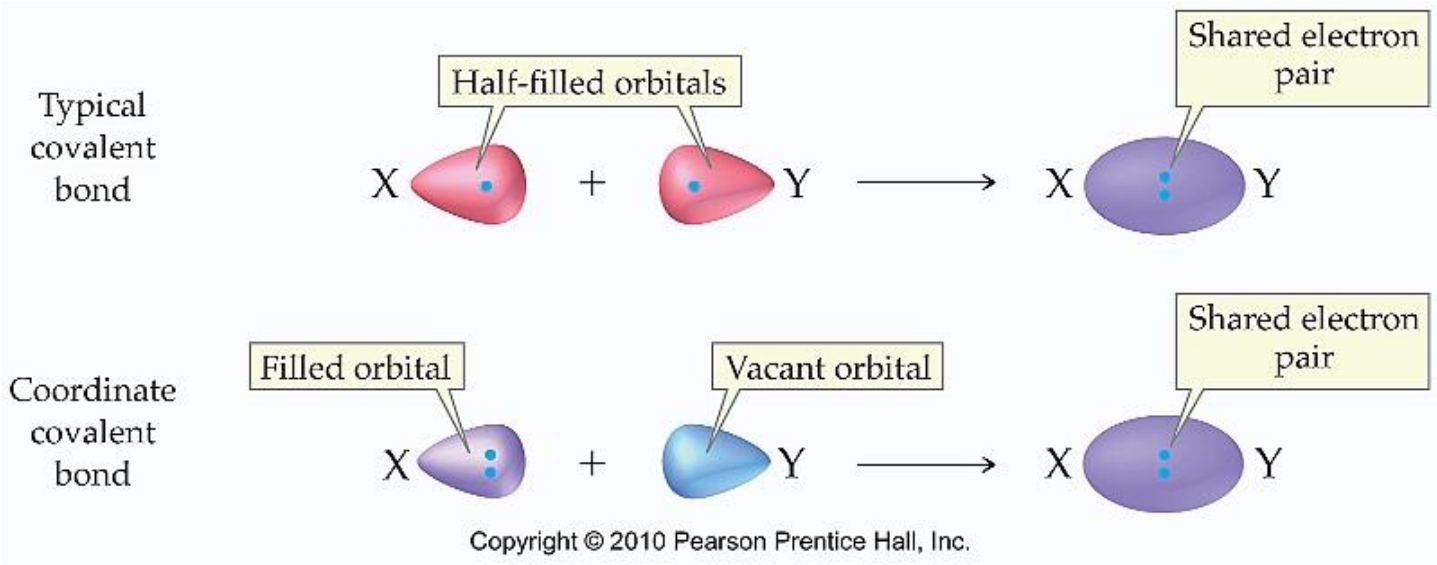
Acetylene—the carbon atoms share 6 electrons in a triple bond.

4.4 Coordinate covalent bonds

In de hiervoor genoemde covalente bindingen droegen beide atomen bij aan de gedeelde elektronen.

Soms doneert één atoom de elektronen.

Gecoördineerde covalente bindingen



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4.4 Coordinate covalent bonds

Bijvoorbeeld NH_4^+

4.5 Characterustics of Molecular Compounds

TABLE 4.1 A Comparison of Ionic and Molecular Compounds

Ionic Compounds	Molecular Compounds
Smallest components are ions (e.g., Na^+, Cl^-)	Smallest components are molecules (e.g., CO_2, H_2O)
Usually composed of metals combined with nonmetals	Usually composed of nonmetals with nonmetals
Crystalline solids	Gases, liquids, or low-melting-point solids
High melting points (e.g., NaCl = 801 °C)	Low melting points (H_2O = 0.0 °C)
High boiling points (above 700 °C) (e.g., NaCl = 1413 °C)	Low boiling points (e.g., H_2O = 100 °C; CH_3CH_2OH = 76 °C)
Conduct electricity when molten or dissolved in water	Do not conduct electricity
Many are water-soluble	Relatively few are water-soluble
Not soluble in organic liquids	Many are soluble in organic liquids

Nu

Eerst oefenen met opdrachten
t/m 4.7

4.6 Molecular Fomulas and Lewis Structures

Verschillende manieren om stoffen weer te geven

Moleculaire formule

- Laat het type en het aantal atomen per molecuul zien.

Structurele formule

- Laat ook zien hoe de atomen met elkaar verbonden zijn via lijntjes.

Lewis structuur

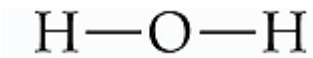
- Laat naast de lijntjes ook de valente elektronen zien die niet gedeeld worden.

4.6 Molecular Fomulas and Lewis Structures

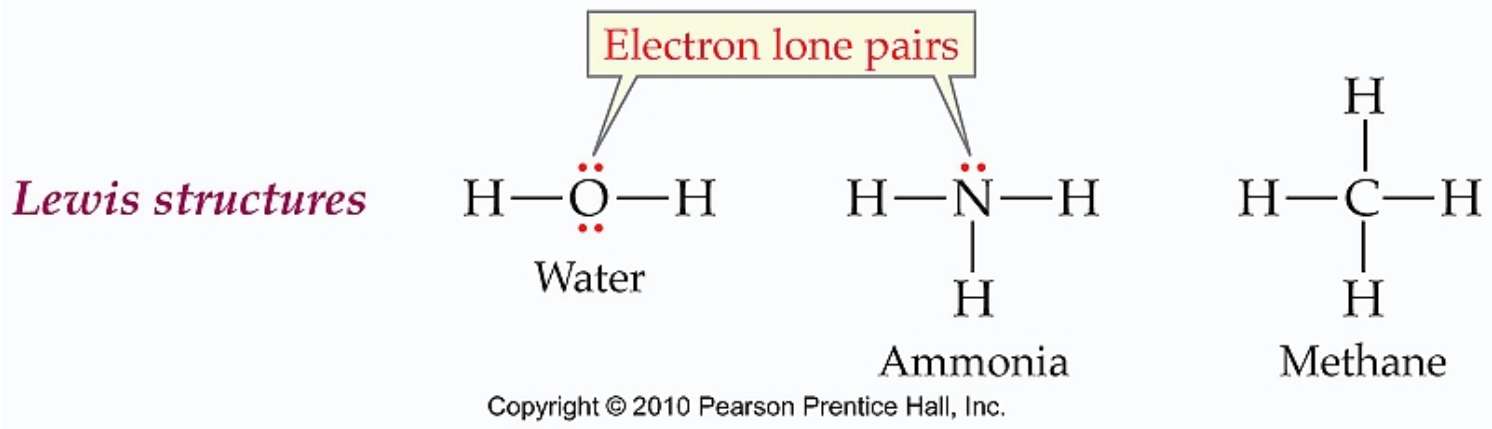
Moleculaire formule

H_2O NH_3 CH_4

Structurele formule

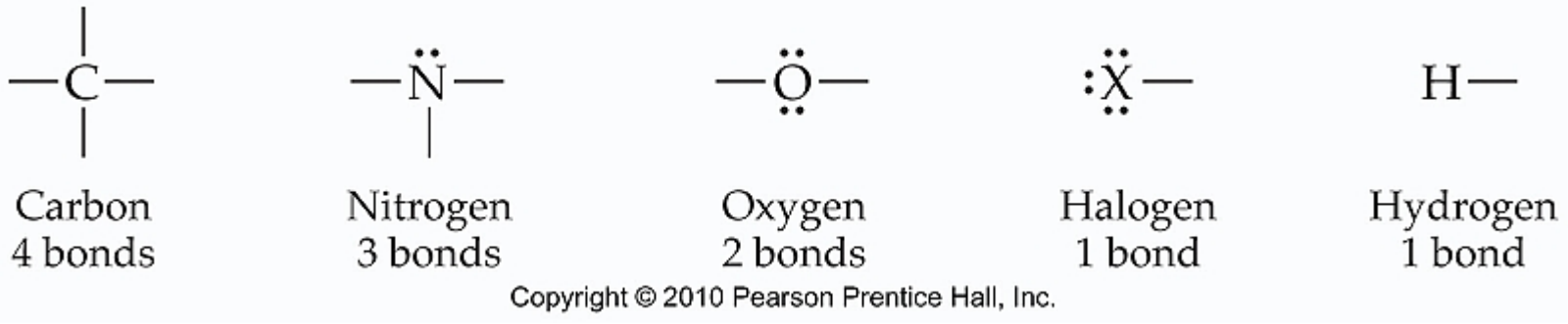


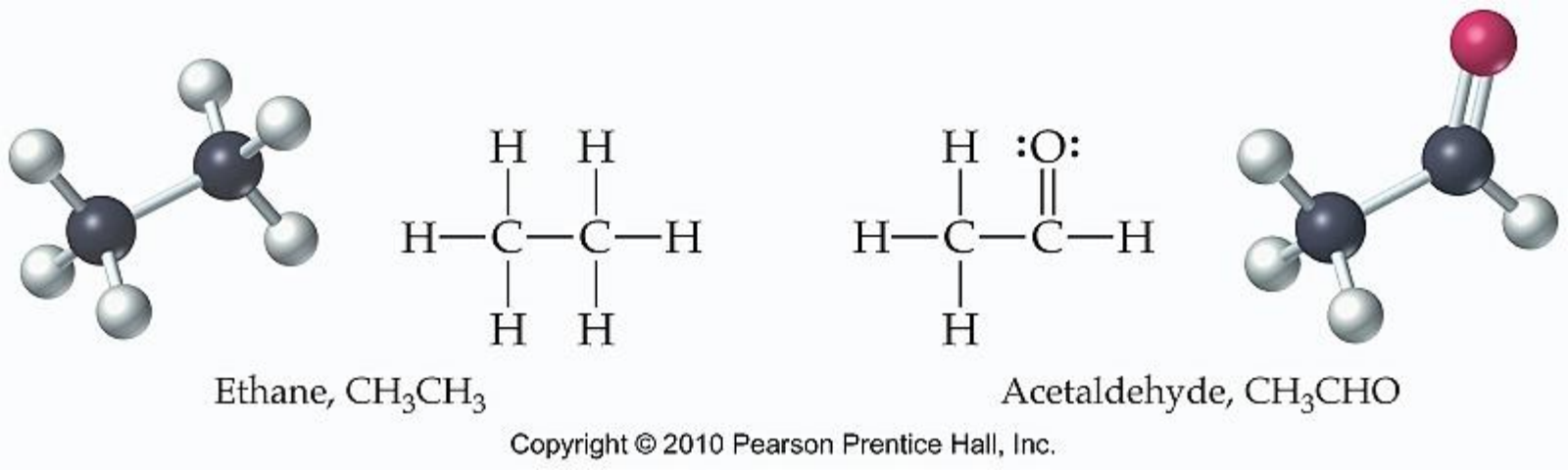
Lewis structuur



4.7 Drawing Lewis Structures

Lewis structuren met C, N, O, X (halogenen), en H





4.7 Drawing Lewis Structures

5 Stappen om Lewis structuren te tekenen.

Stap 1: Vind het totale aantal valente elektronen.

STEP 1: Find the total number of valence electrons of all atoms in the molecule or ion. For a polyatomic ion, add one electron for each negative charge or subtract one for each positive charge. In PCl_3, for example, phosphorus (group 5A) has 5 valence electrons and chlorine (group 7A) has 7 valence electrons, giving a total of 26:

$$P + (3 \times Cl) = PCl_3$$

$$5e^- + (3 \times 7e^-) = 26e^-$$

In OH^-, the total is 8 electrons (6 from oxygen, 1 from hydrogen, plus 1 for the negative charge). In NH_4^+, the total is 8 (5 from nitrogen, 1 from each of 4 hydrogens, minus 1 for the positive charge).

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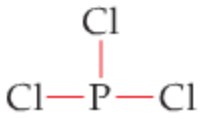
4.7 Drawing Lewis Structures

Stap 2: Teken lijnen tussen de atomen

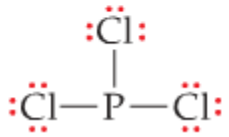
STEP 2: Draw a line between each pair of connected atoms to represent the two electrons in a covalent bond. Remember that elements in the second row of the periodic table form the number of bonds discussed earlier in this section, whereas elements in the third row or lower can use more than 8 electrons and form more than the "usual" number of bonds (Figure 5.4). A particularly common pattern is that an atom in the third row or lower occurs as the central atom in a cluster. In PCl_3, for example, the phosphorus atom is in the center with the three chlorine atoms bonded to it:



4.7 Drawing Lewis Structures

Stap 3: Voeg elektronen toe aan de atomen die buiten het centrale atoom liggen.

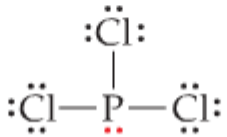
STEP 3: Add lone pairs so that each atom connected to the central atom (except H) gets an octet. In PCl_3, each Cl atom needs three lone pairs:



4.7 Drawing Lewis Structures

Stap 4: Plaats de overgebleven elektronen bij het centrale atoom.

STEP 4: Place all remaining electrons in lone pairs on the central atom. In PCl_3, we have used 24 of the 26 available electrons—6 in three single bonds and 18 in the three lone pairs on each chlorine atom. This leaves 2 electrons for one lone pair on phosphorus:



4.7 Drawing Lewis Structures

Stap 5: Mocht er geen octet aanwezig zijn bij het centrale atoom, voeg verbindingen toe met één van de andere randatomen.

STEP 5: **If the central atom does not yet have an octet after all electrons have been assigned, take a lone pair from a neighboring atom and form a multiple bond to the central atom.** In PCl_3, each atom has an octet, all 26 available electrons have been used, and the Lewis structure is finished.

Even oefenen

Teken de Lewisstructuur voor de volgende moleculen:

- HCN C_2H_3Cl SO_2

Stap 1: Vind het totale aantal valente elektronen.
Stap 2: Teken lijnen tussen de atomen
Stap 3: Voeg elektronen toe aan de atomen die buiten het centrale atoom liggen.
Stap 4: Plaats de overgebleven elektronen bij het centrale atoom.
Stap 5: Mocht er geen octet aanwezig zijn bij het centrale atoom, voeg verbindingen toe met één van de andere randatomen.

Eerst even herhalen

Teken de Lewis structuur van:

NH_2OH CO_3^{2-}

Vandaag

Nakijken opdrachten t/m 4.13

Uitleg 4.8 t/m 4.11

- Vormen van moleculen

Maken opdrachten

4.8 The Shapes of Molecules

Moleculen hebben een bepaalde vorm.

Atomen van een watermolecuul zijn bijvoorbeeld met elkaar verbonden onder een hoek van 104,5°

Waarom?

4.8 The Shapes of Molecules

Moleculen hebben een bepaalde vorm.

Atomen van een watermolecuul zijn bijvoorbeeld met elkaar verbonden onder een hoek van 104,5°

Waarom?

Elektronenwolken stoten elkaar af.

Valence-shell electorn-pair repulsion (VSEPR) model

4.8 The Shapes of Molecules

Toepassen van het VSEPR model

1. Teken de Lewis structuur en identificeer van welk atoom je de geometrie wilt weten.
2. Tel het aantal elektronenladingswolken die zich rondom dat atoom bevinden.
3. Voorspel de vorm van het molecuul en ga er vanuit dat de wolken zich zo ver mogelijk van elkaar verwijdert houden.

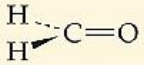
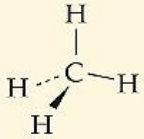
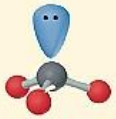
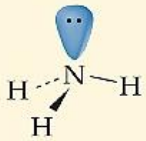
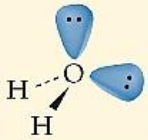
4.8 The Shapes of Molecules

Bijv.

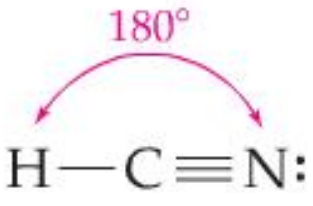
1. H_2O
2. CO_2

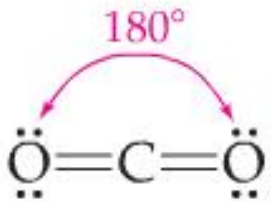
4.8 The Shapes of Molecules

TABLE 5.1 Molecular Geometry Around Atoms with 2, 3, and 4 Charge Clouds

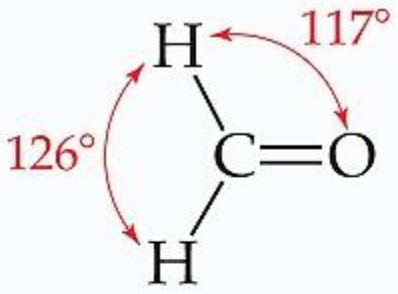
NUMBER OF BONDS	NUMBER OF LONE PAIRS	TOTAL NUMBER OF CHARGE CLOUDS	MOLECULAR GEOMETRY	EXAMPLE
2	0	2	 Linear	O=C=O
3	0	3	 Planar triangular	
2	1		 Bent	
4	0	4	 Tetrahedral	
3	1		 Pyramidal	
2	2		 Bent	

These molecules are linear, with bond angles of 180°.

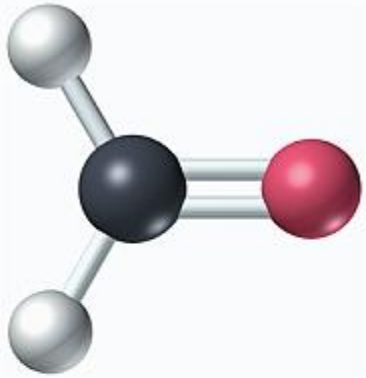


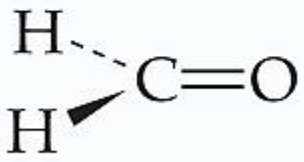


A formaldehyde molecule is planar triangular, with bond angles of roughly 120°. Note: solid wedges and dashed lines indicate bonds projecting out from and into the plane of the page, respectively.

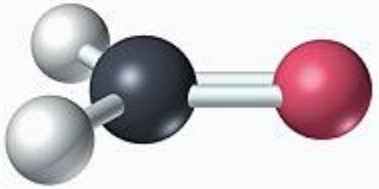


Top view

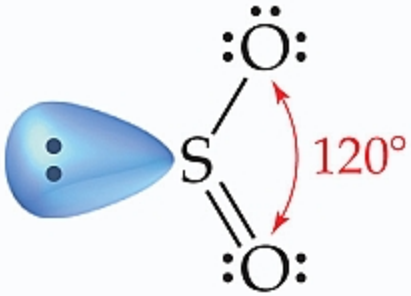




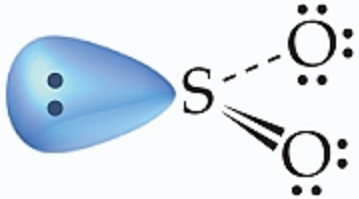
Side view



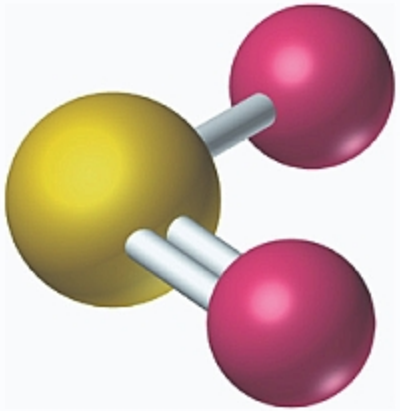
An SO_2 molecule is bent, with a bond angle of approximately 120°.

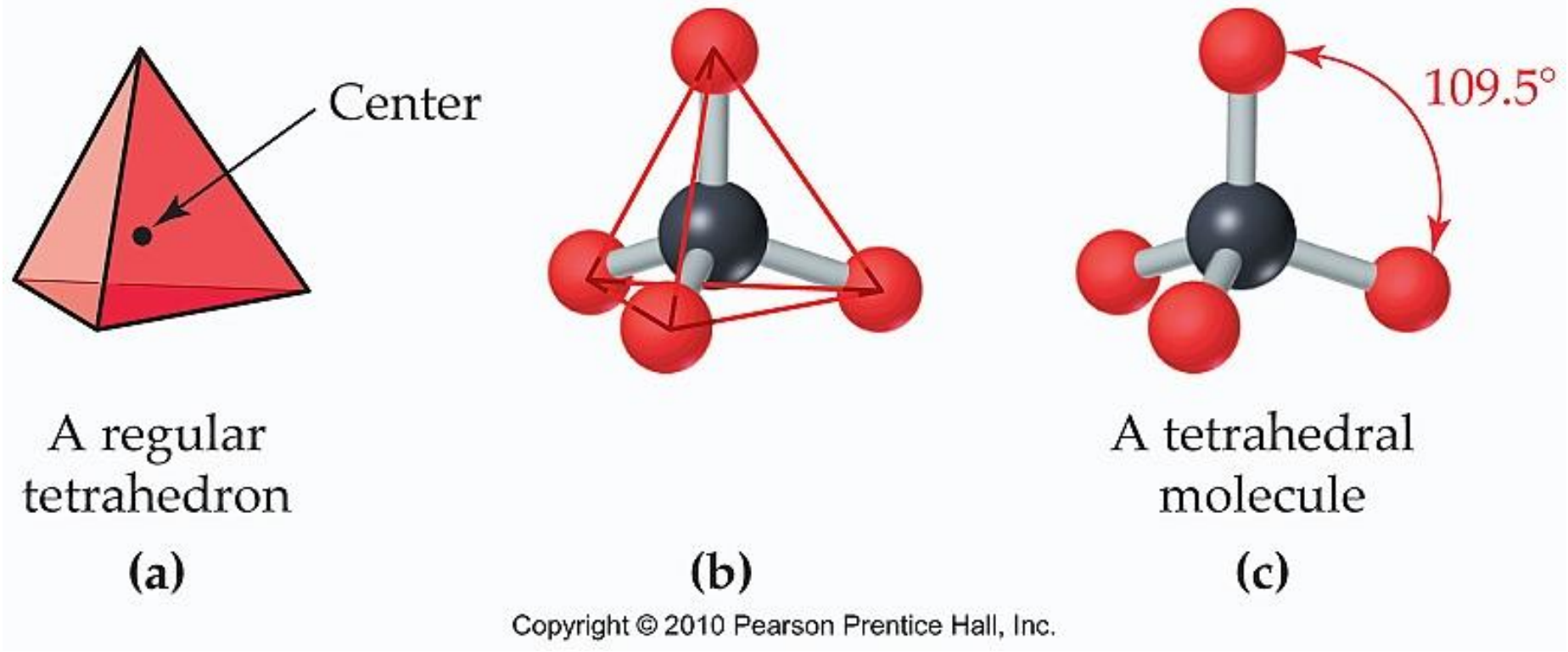


Top view

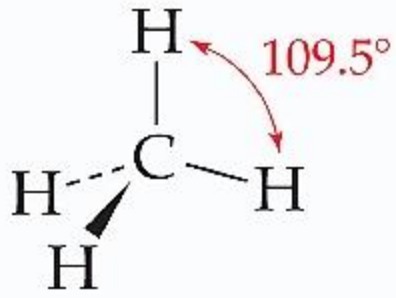


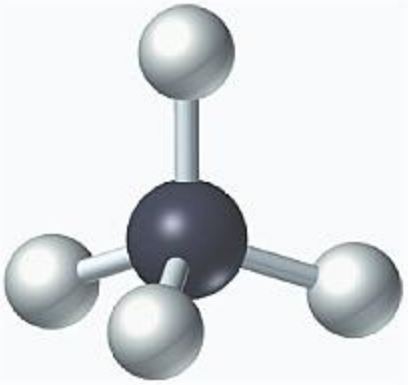
Side view



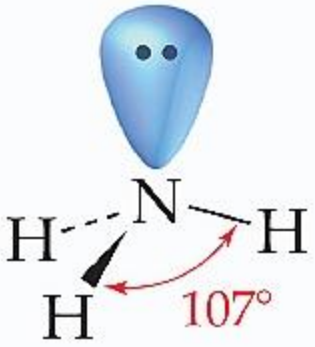


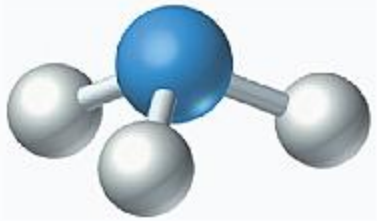
A methane molecule is tetrahedral, with bond angles of 109.5°.



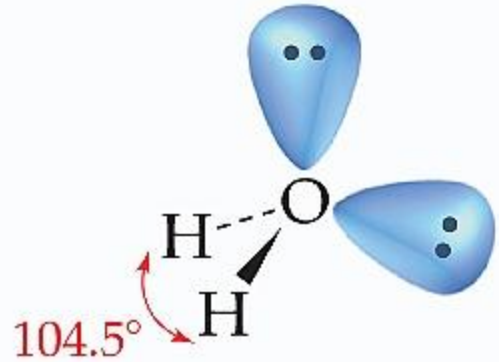


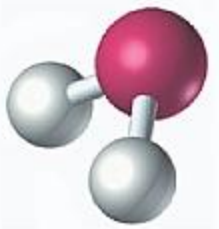
An ammonia molecule is pyramidal, with bond angles of 107°.



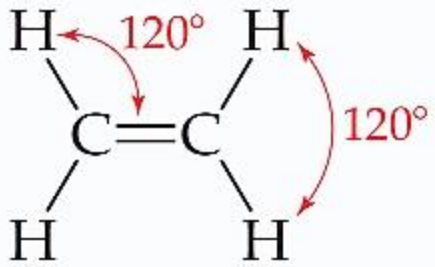


A water molecule is bent, with a bond angle of 104.5°.

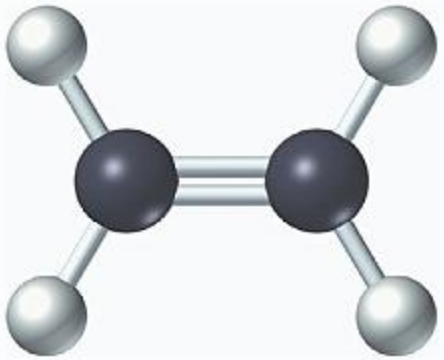


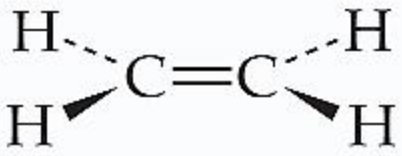


The ethylene molecule is planar, with bond angles of 120°.

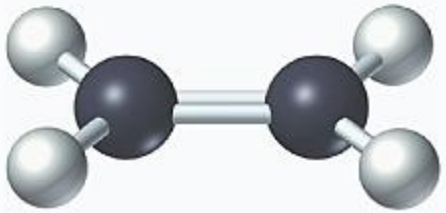


Top view

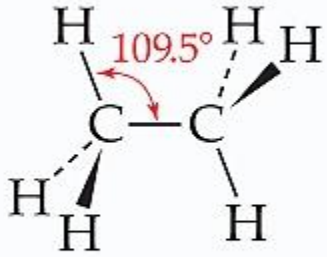


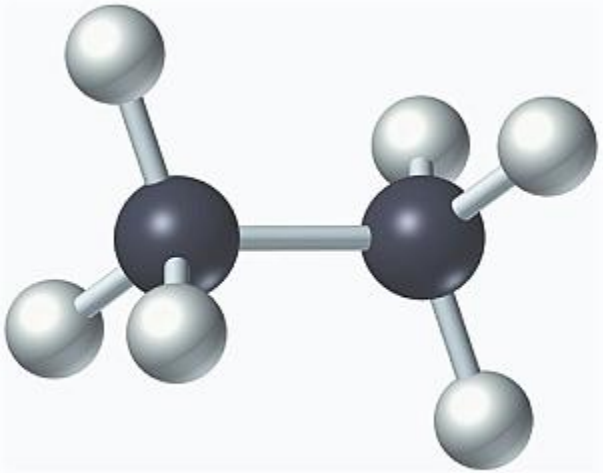


Side view



The ethane molecule has tetrahedral carbon atoms, with bond angles of 109.5°.





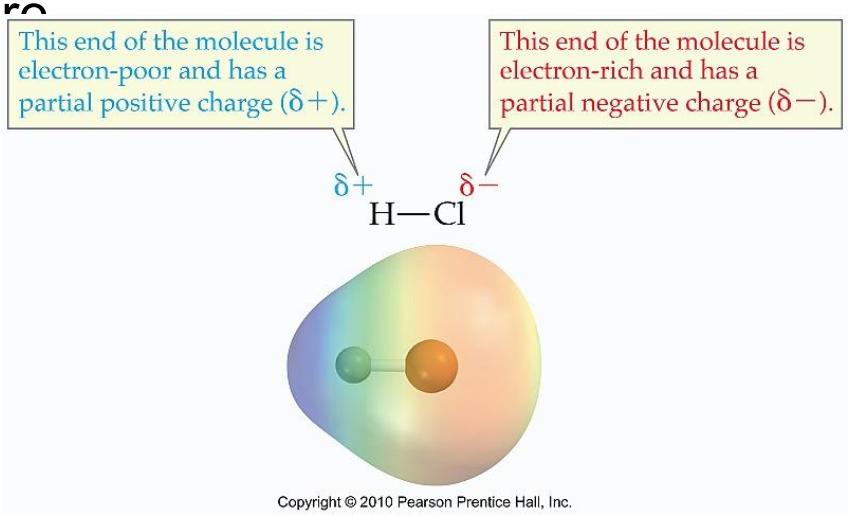
4.8 The Shapes of Molecules

Oefenen – Vorm van…

1. H_3O^+
2. CH_3CHO

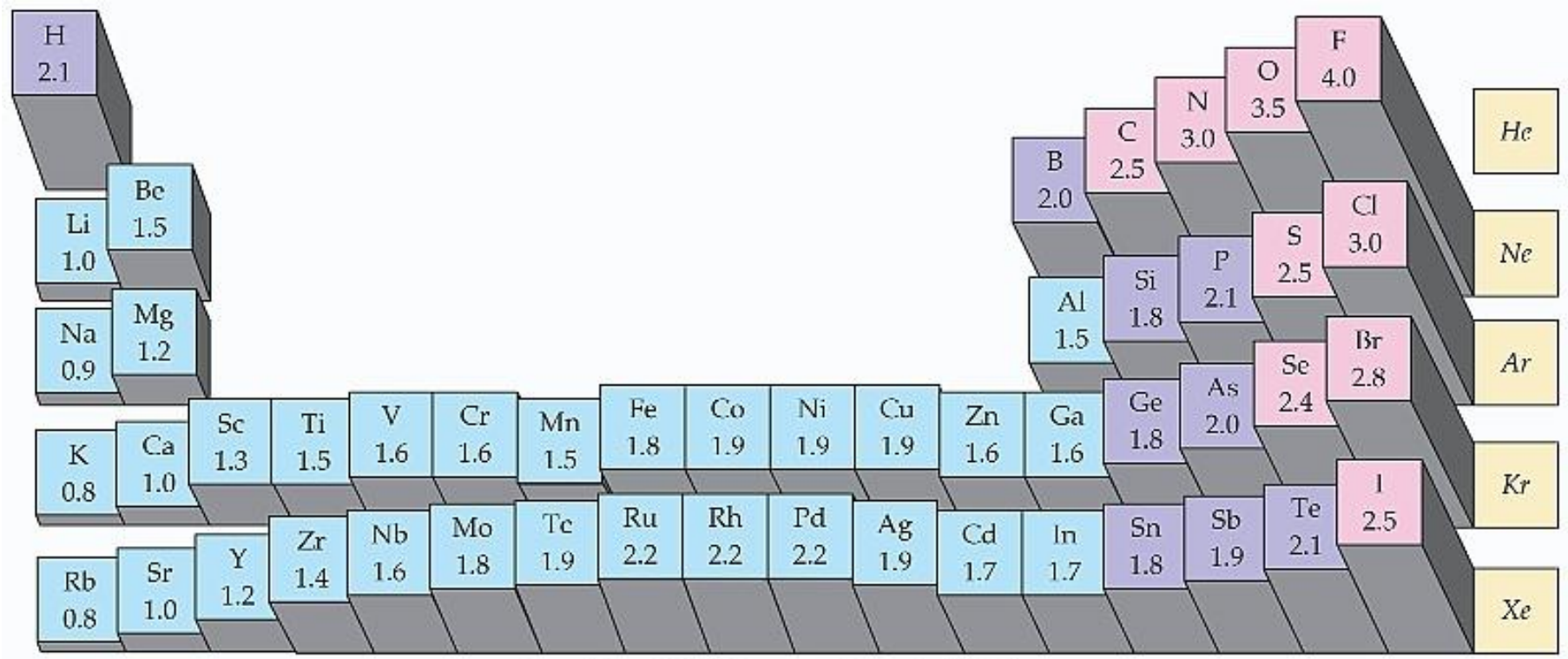
4.9 Polar Covalent Bonds and Electronegativity

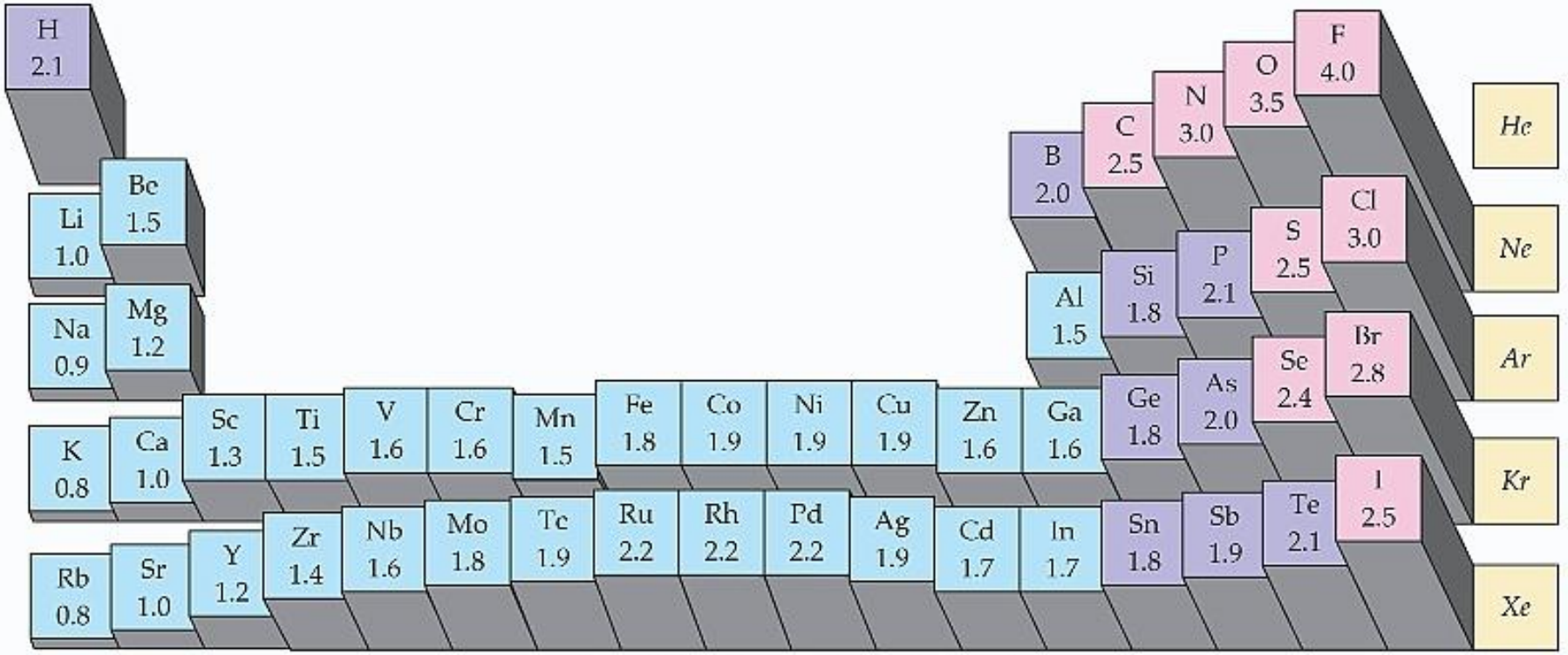
- Polariteit in het molecuul
- Partiële lading (δ+ en δ-)
- De elektronen van een binding bevinden zich wat meer bij het ene atoom dan bij het ander



4.9 Polar Covalent Bonds and Electronegativity

Elektronegativiteit = de maat voor de kracht waarmee atomen elektronen naar zich toe trekken.





Less polar

$\delta+ \quad \delta-$
C—N

Electronegativity difference:

$3.0 - 2.5 = 0.5$

More polar

$\delta+ \quad \delta-$
C—O

Electronegativity difference:

$3.5 - 2.5 = 1.0$

4.9 Polar Covalent Bonds and Electronegativity

Elektronegativiteit = de maat voor de kracht waarmee atomen elektronen naar zich toe trekken.

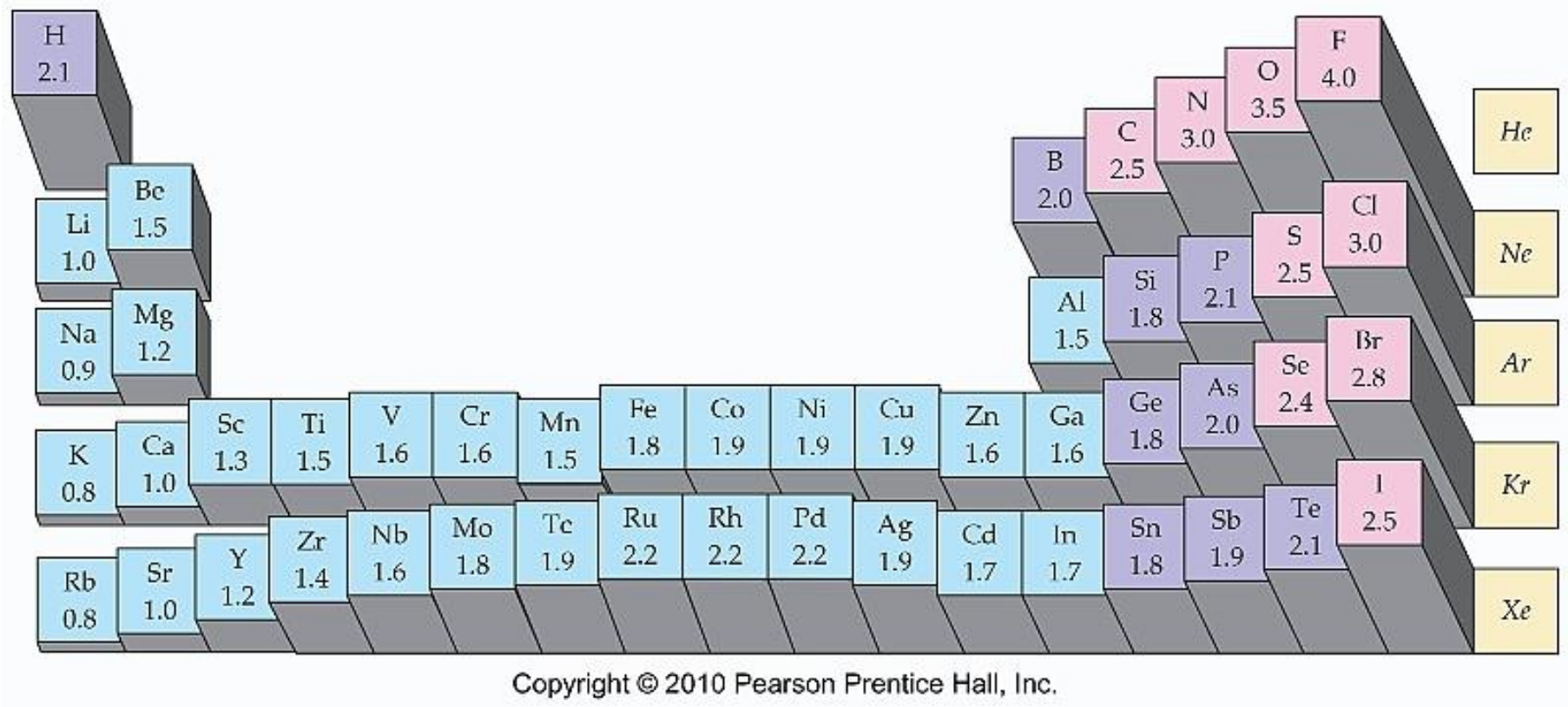
E.N difference		Type of bond
0 — 0.4	~	Covalent
0.5 — 1.9	~	Polar covalent
2.0 and above	~	Ionic

4.9 Polar Covalent Bonds and Electronegativity

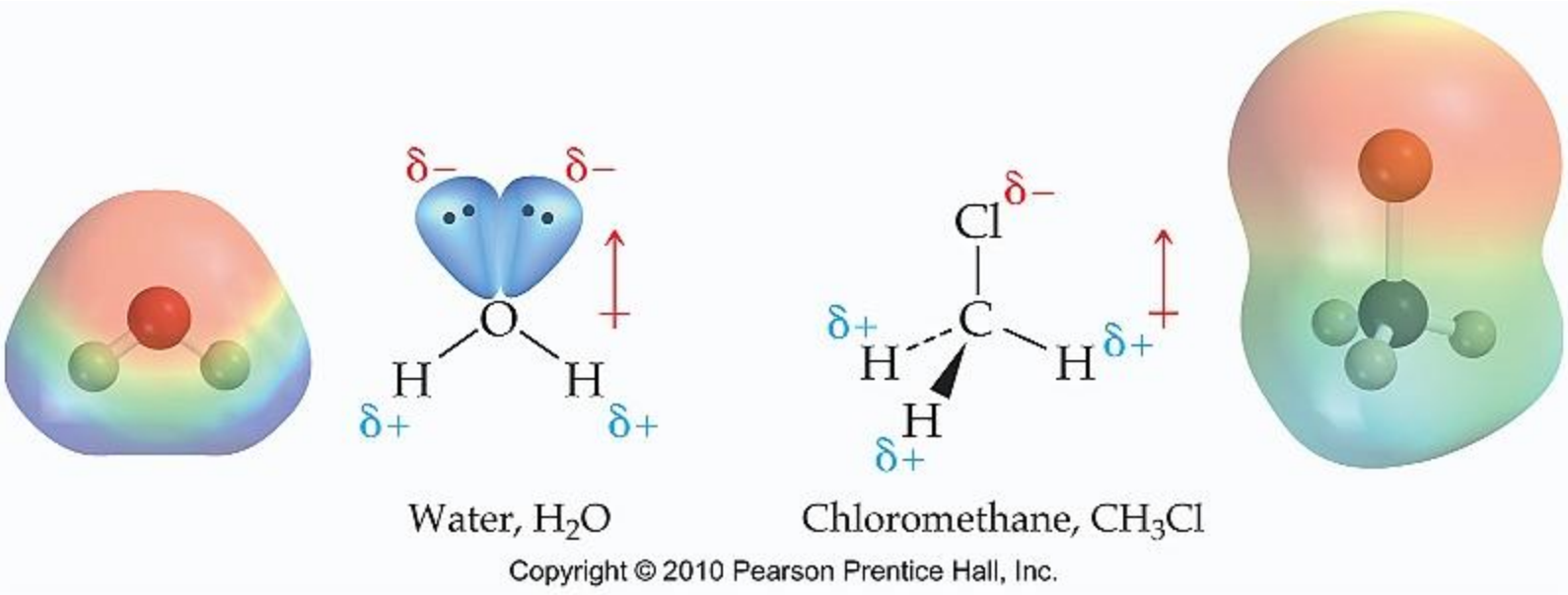
C en Br?

N en H?

Li en Cl

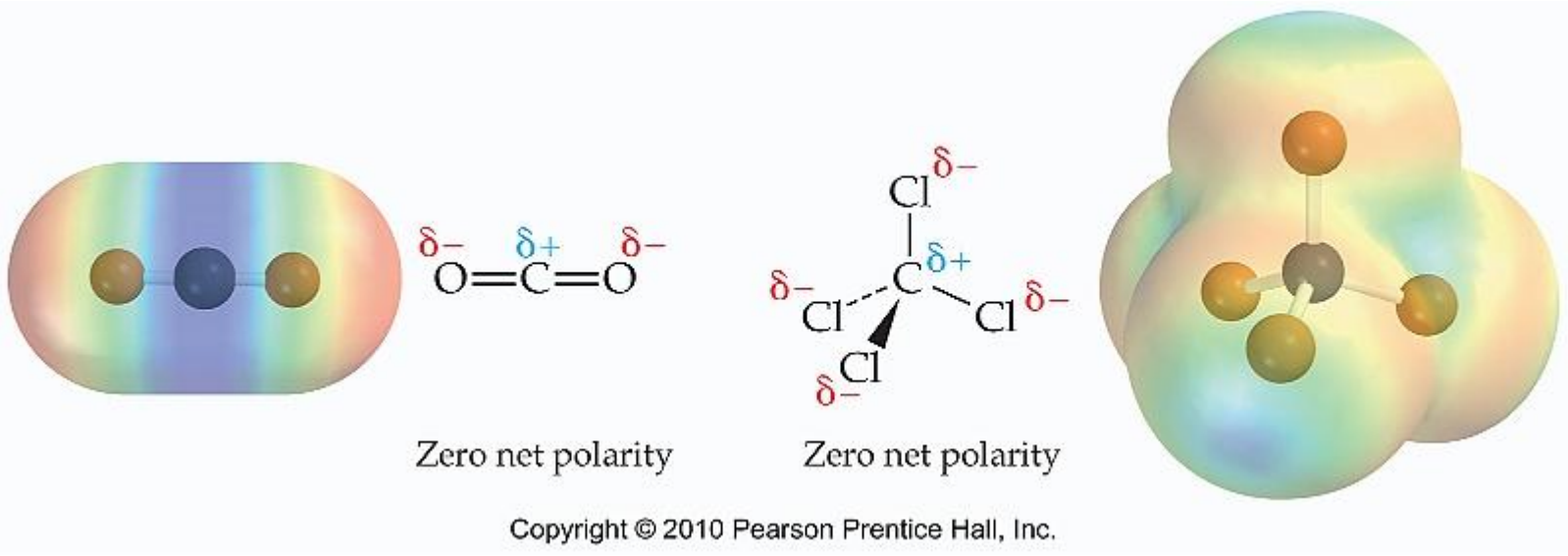


4.10 Polar molecules



4.10 Polar molecules

- Wel een polaire binding, maar geen dipool!

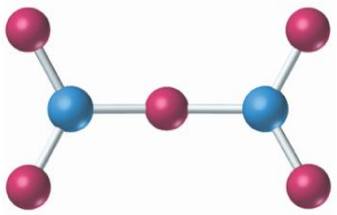


4.11 Naming Binary Molecular Compounds

- Bij het benoemen van een stof, eerst de metalen dan de niet-metalen.
- Anders links op de periodieke tabel komt eerst en meer naar rechts komt later.

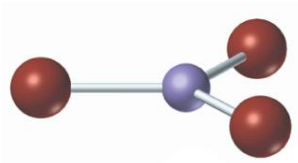
TABLE 4.3 Numerical Prefixes Used in Chemical Names

Number	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-
6	hexa-
7	hepta-
8	octa-
9	nona-
10	deca-



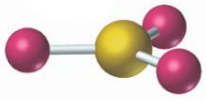
N_2O_5

*Di*nitrogen *pent*oxide



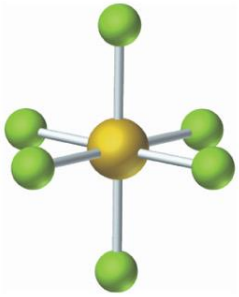
BBr_3

Boron *tri*bromide



SO_3

Sulfur *tri*oxide



SF_6

Sulfur *hexa*fluoride

Bronnen

Afbeeldingen afkomstig van:

- McMurry - Fundamentals of general, organic, and biological chemistry. 7th edition, uitgever: Pearson.
  - Veplicht boek boekenlijst opleiding
- http://www.accessexcellence.org/RC/VL/GG/ecb/ecb_images/02_06_stable_arrangement.jpg (Geraadpleeg op 23-8-2019)
- https://mulberrylearning.com/wp-content/uploads/2018/05/minion-bananas-300x188.jpg (Geraadpleeg op 23-8-2019)