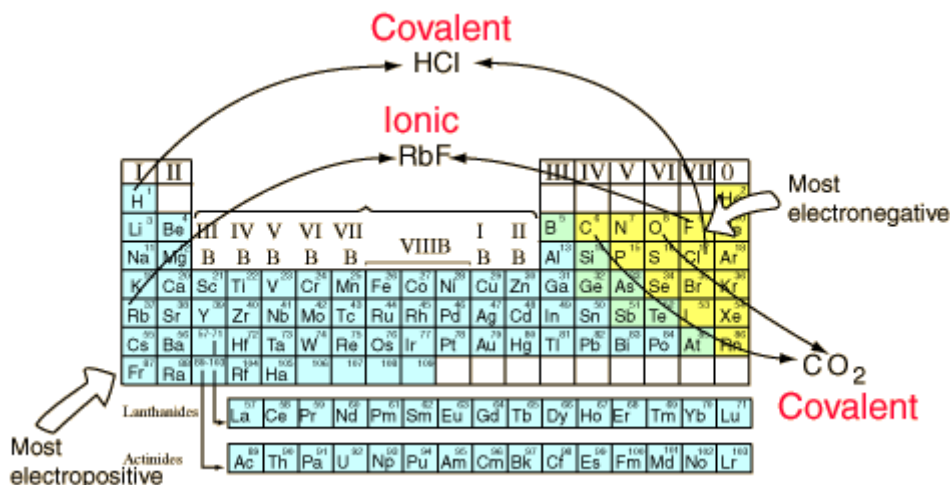


8 CHEMICAL BONDING

1. Warm-up

- What specific tendencies to form bonds can you predict from the position in the periodic table?
- In general, what properties do the different types of bonds lead to?



2. Use these words to fill in the gaps 1 – 6.

upper right stable bottom left electronegativity covalent ionic

You can anticipate some things about bonds from the positions of the constituents in the periodic table. Elements from opposite ends of the periodic table will generally form **1**..... bonds. They will have large differences in **2**..... and will usually form positive and negative ions. The elements with the largest electronegativities are in the **3**..... of the periodic table, and the elements with the smallest electronegativities are on the **4**..... . If these extremes are combined, such as in RbF, the dissociation energy is large. As can be seen from the illustration above, hydrogen is the exception to that rule, forming **5**..... bonds. Elements which are close together in electronegativity tend to form covalent bonds and can exist as **6**..... free molecules. Carbon dioxide is a common example.

3. Sort out the information a-h under the right heading: Ionic Compounds or Covalent Compounds

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> a) Poor electrical conductors in all phases b) Conduct electricity when melted c) Many soluble in water but not in nonpolar liquid d) Many soluble in nonpolar liquids but not in water | <ul style="list-style-type: none"> e) Crystalline solids (made of ions) f) Low melting and boiling points g) High melting and boiling points h) Gases, liquids, or solids (made of molecules) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Comparison of Properties of Ionic and Covalent Compounds

Because of the nature of ionic and covalent bonds, the materials produced by those bonds tend to have quite different macroscopic properties. The atoms of covalent materials are bound tightly to each other in stable molecules, but those molecules are generally not very strongly attracted to other molecules in the material. On the other hand, the atoms (ions) in ionic materials show strong attractions to other ions in their vicinity. This generally leads to low melting points for covalent solids, and high melting points for ionic solids. For example, the molecule carbon tetrachloride is a non-polar covalent molecule, CCl₄. It's melting point is -23°C. By contrast, the ionic solid NaCl has a melting point of 800°C.

Ionic Compounds

- 1.
- 2.
- 3.
- 4.

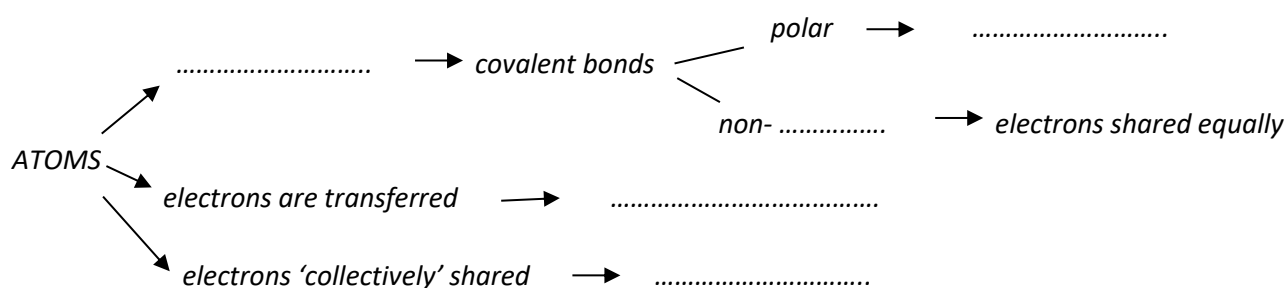
Covalent Compounds

- 1.
- 2.
- 3.
- 4.

<http://hyperphysics.phy-astr.gsu.edu/hbase/Chemical/bond2.html#c1>

4. Listen and take notes. <https://www.youtube.com/watch?v=7DjsD7Hcd9U> 0.20 - 1.52

A) Complete the gaps in the diagram



B) Explain how you identify the type of bond and give examples 4.00 – 8.26

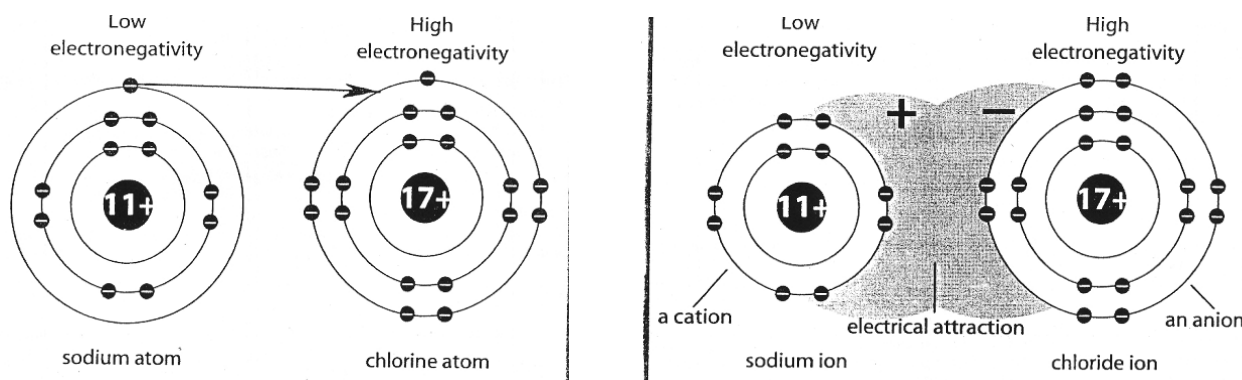
Non-polar

Polar

Ionic

5. Ionic bond

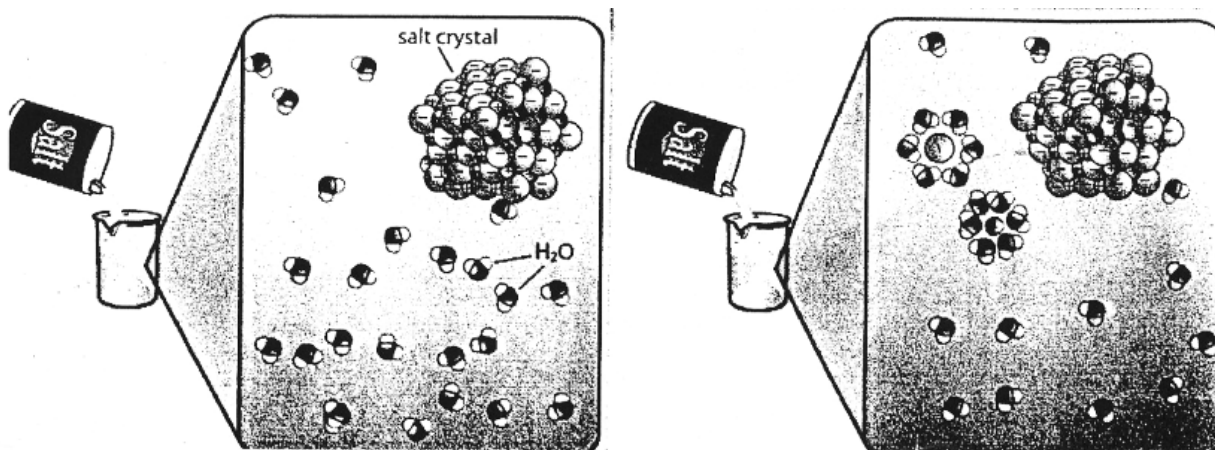
- What happens when sodium reacts with chlorine?



- A. The first thing that happens in the formation of an ionic bond is that the sodium atom
- B. In the next step sodium lost an electron, that's why it has
- C. The two atoms take on electrical and are called
- D. Neutral Cl atom is called but after it has received an electron it becomes Cl⁻, called.....

3.30 – 5.19 Ionic Bonding Introduction by Tyler DeWitt <https://www.youtube.com/watch?v=Qf07-8Jhhpc>

- What happens while dissolving sodium chloride in water?



Pronounce the words correctly:

electronegativity chlorine loosely ions cation anion partial charges dissolve sphere

6. Covalent bond: Read the text and suggest a word for each gap, then listen and compare.

A covalent bond results when two atoms *s*_____ electrons. In the case of two hydrogen atoms, each shares its single electron with the other. This sharing allows each to fill its electron *s*_____ with two electrons. The pair of shared electrons constitutes a covalent *s*_____ bond.

Let's now consider oxygen, an atom with eight electrons. Two electrons fill the *i*_____ shell, and the other six electrons reside in the next shell. This outer shell needs two more electrons to *c*_____ it (the octet rule). Two oxygen atoms form a covalent *d*_____ bond by sharing two electron pairs from their outer shells.

Carbon is perhaps the most versatile element on Earth, in large part because it contains only four electrons in a shell that can *h*_____ eight. To fill its outer shell, carbon forms four covalent bonds with up to four other atoms.

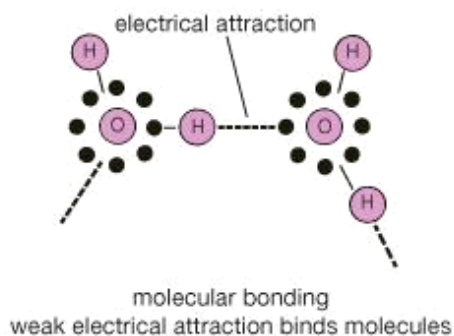
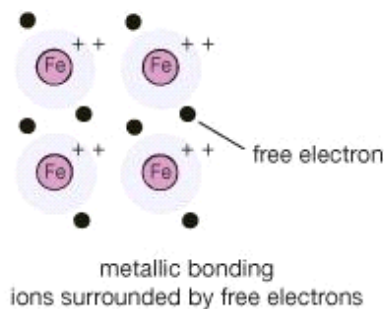
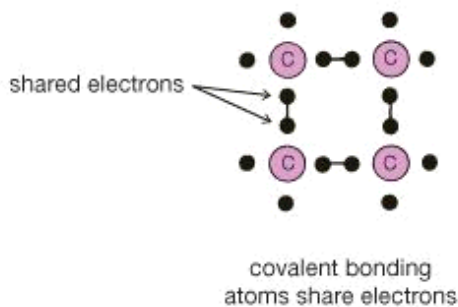
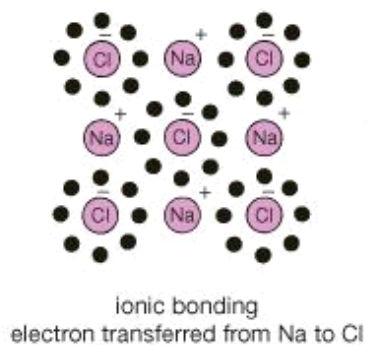
In a molecule of *m*_____, carbon shares electrons with hydrogen atoms, forming four covalent single bonds. Although this molecule is relatively simple, carbon often forms the *b*_____ of large, complex molecules. With each carbon atom able to bond to four other atoms, carbon-based *m*_____ are incredibly diverse.

Triple bonds are rare, but nitrogen gas molecules (the most *a*_____ molecule in the air we breathe) form triple bonds. The two nitrogen atoms share three pairs of electrons, allowing each to have eight electrons in its *o*_____ electron shell.

7. What is specific for the types of bonds in the pictures below?

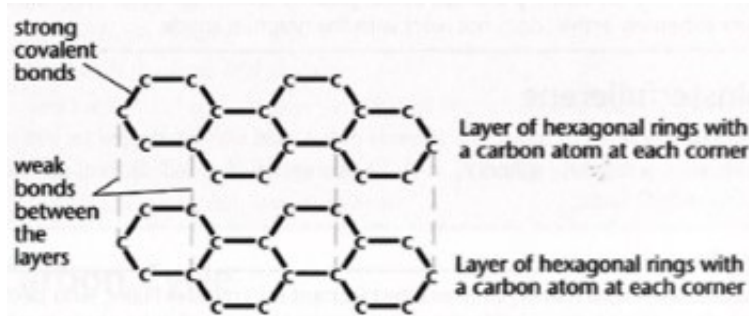
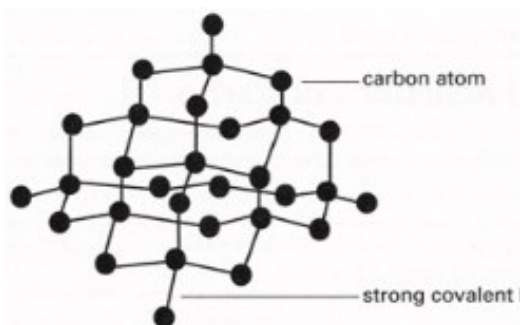
You can use this vocabulary:

Interaction of positive and negative ions, attraction between (the constituents), result in electrical neutrality, achieve noble gas configuration, involve sharing of one, two, or three pairs of electrons, form of dipole interaction, cloud of delocalized electrons, structure of positively charged ions



© 2010 Encyclopædia Britannica, Inc.

8. Use the pictures and explain why graphite and diamond have different properties.



<http://www.slideshare.net/matcol/carbon-chemistry>

Complete the text with the adjectives and nouns from the box.



In graphite the carbon atoms are arranged in 1 _____ sheets, and each atom has only three near neighbours. The covalent bonds between 2 _____ carbons within each layer are quite strong and are called σ bonds. The fourth valence electron in carbon has its orbital 3 _____ to the plane. This orbital bonds weakly with the similar orbitals on all three neighbours, forming π bonds. The four bonds for each carbon atom in the graphite structure are not arranged in a 4 _____; three are in a plane. The 5 _____ arrangement results in strong bonding, although not as strong as the bonding in the diamond configuration. The bonding between layers is quite weak and arises from the van der Waals interaction; there is much slippage parallel to the layers. Diamond and graphite form an interesting contrast: diamond is the hardest material in nature and is used as an 6 _____, while graphite is used as a 7 _____.

<https://www.britannica.com/science/crystal/Types-of-bonds#ref506334>

Sources J. Shipman, J. Wilson, A. Todd, An Introduction to Physical Science, Houghton Mifflin, 2006, p.312 – 329