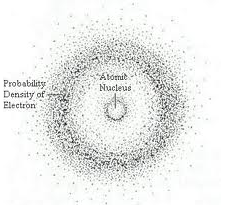
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| **Chemistry 11**  **Atomic Theory V** | **Name: Date:**  **Block:** |

|  |
| --- |
| 1. **Atomic Radius** 2. **Ionization Energy** 3. **Electronegativity** 4. **Chemical Bonding** |

|  |
| --- |
| **Atomic Radius** |

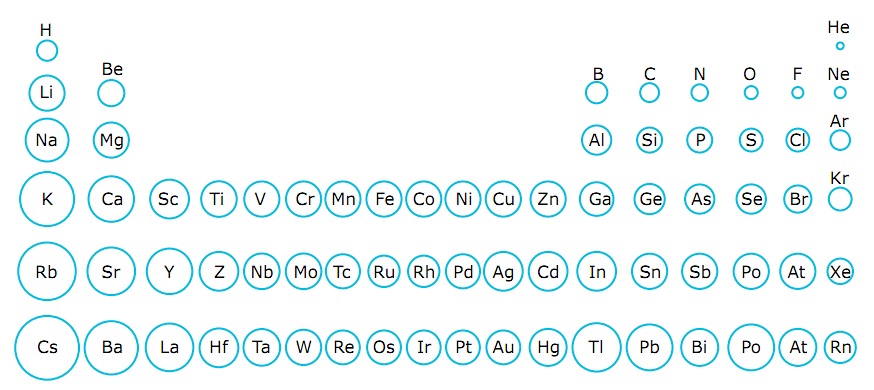
**Periodic Trends**

* As we move across a period or down a chemical family, there are regular changes in elemental properties.



**The size of an atom**

* The volume of an atom is the result of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of electrons.
* The outer boundary of an atom depends on the size of a cloud in which electrons spend approximately \_\_\_\_\_\_\_ % of their time.
* What affects the size of an atom’s electron cloud?



**As we move DOWN a family…**

* As the number of energy levels (n) increases, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This makes the atom \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* **Draw the Bohr Diagrams for the following atoms:**

**Sodium Potassium Rubidium**

**As we move ACROSS a period…**

* As the atomic number increases, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The greater the positive charge on the nucleus, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the size of the radius

**Consider this…**

Rank the following from largest to smallest by determining:

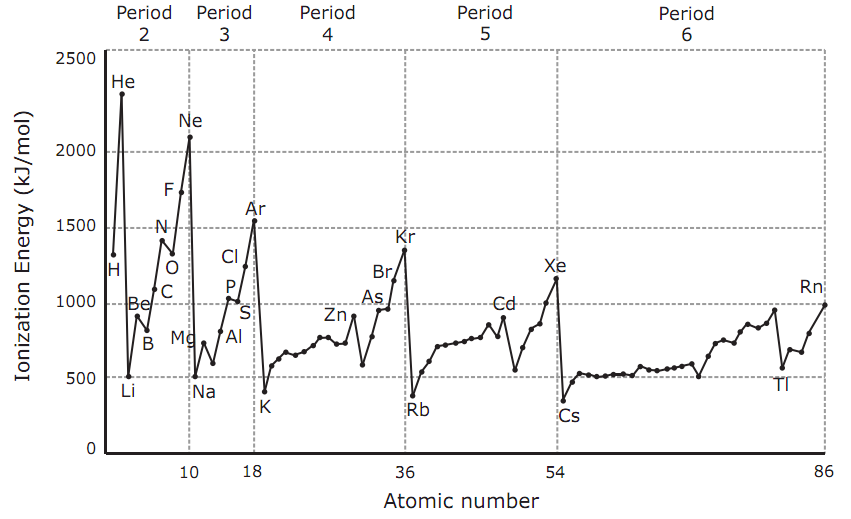
* How many electrons are in each?
* How many protons are in each?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Al3+** | **F-** | **Mg2+** | **N3-** | **Na+** | **Ne** | **O2-** |
| # of electrons |  |  |  |  |  |  |  |
| # of protons |  |  |  |  |  |  |  |

Ranking: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| **Ionization Energy** |

**Ionization Energy:** The \_\_\_\_\_\_\_\_\_\_\_\_\_ required to remove an electron from a neutral atom.



Ionization Energy tells us how strongly an atom holds onto its outermost electrons.

* A large atom has outer electrons that are held \_\_\_\_\_\_\_\_\_\_\_\_ strongly
* A small atom has outer electrons that are held \_\_\_\_\_\_\_\_\_\_\_\_\_ strongly

This is because of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Shielding Effect: The weakening of the attraction between the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons and \_\_\_\_\_\_\_\_\_\_\_ because the electrons in the inner shells are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the outer electrons

In summary:

* As atomic radius increases…
  + Electrons are held \_\_\_\_\_\_\_\_\_\_\_ tightly
  + It takes \_\_\_\_\_\_\_\_\_\_ energy to remove electrons
  + Ionization energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* As atomic radius decreases…
  + Electrons are held \_\_\_\_\_\_\_\_\_\_\_ tightly
  + It takes \_\_\_\_\_\_\_\_\_\_ energy to remove electrons
  + Ionization energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

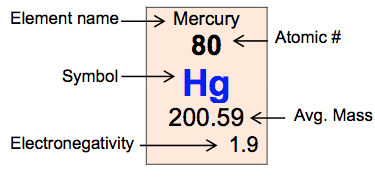
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| **Electronegativity** |

**Electronegativity**

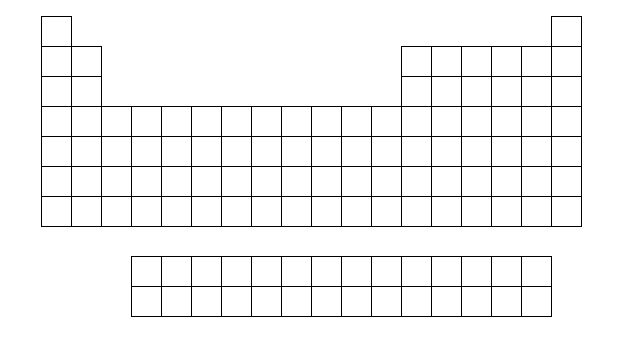
Electron affinity is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Electronegativity is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Smaller atoms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ at attracting electrons because their bonded electrons are so \_\_\_\_\_\_\_\_\_\_\_ to their nucleus
* Therefore, smaller atoms have a \_\_\_\_\_\_\_\_\_\_\_\_ electronegativity (EN)



* **As atomic radius increases…**
  + The nucleus is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the bonding electrons
  + The atom has a \_\_\_\_\_\_\_\_\_\_\_\_\_ ability to attract an electron
  + Electronegativity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **As atomic radius decreases…**
  + The nucleus is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to the bonding electrons
  + The atom has a \_\_\_\_\_\_\_\_\_\_\_\_\_ ability to attract an electron
  + Electronegativity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Summary…**

**Decreases or increases?**

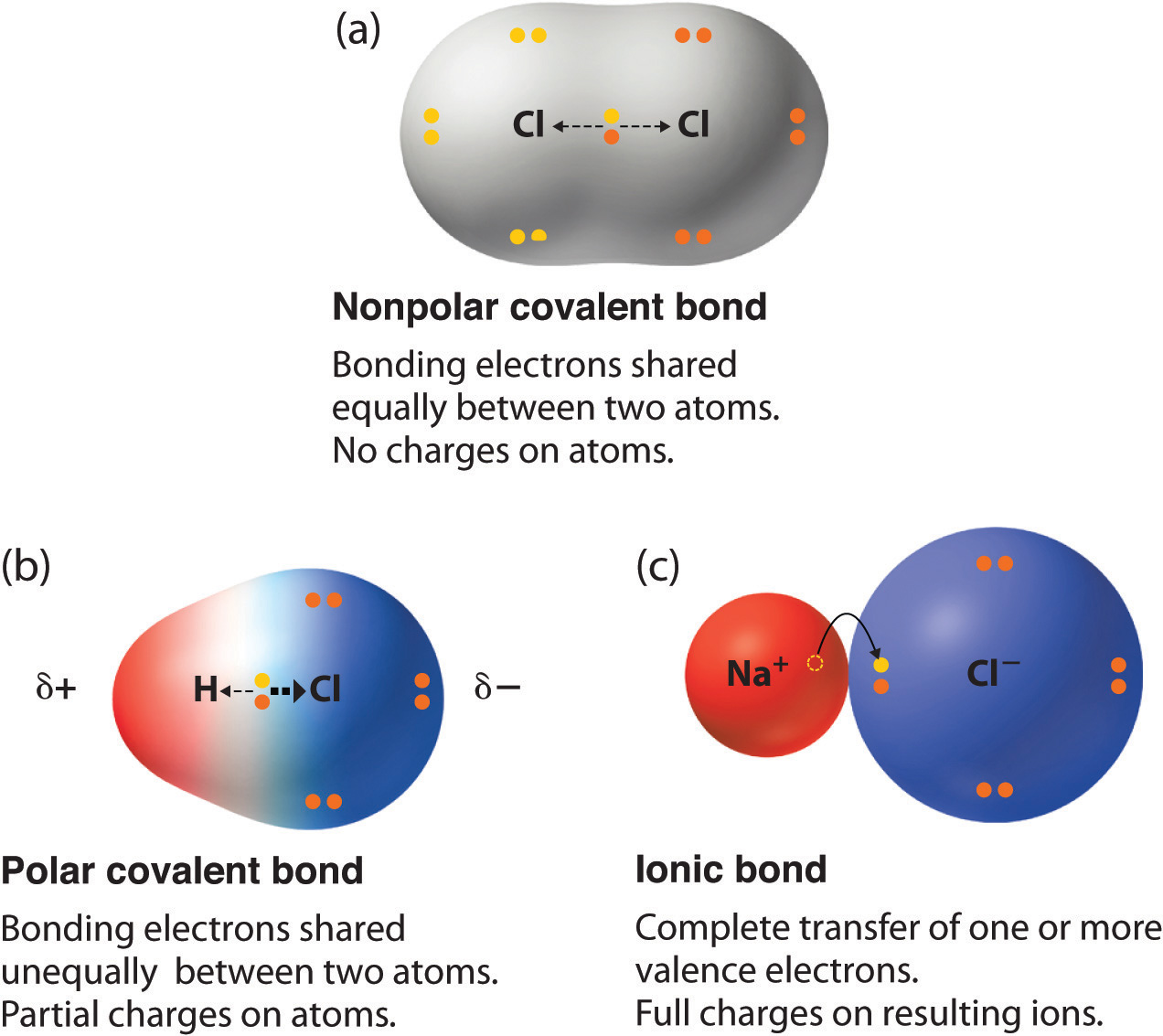
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|  | **Moving LEFT to RIGHT Across A Period** | **Moving DOWN a Chemical Family** |
| **Atomic Size** |  |  |
| Reason: |  |  |
| **Ionization Energy** |  |  |
| Reason: |  |  |
| **Electronegativity** |  |  |
| Reason: |  |  |

|  |
| --- |
| **Chemical Bonding** |

|  |  |
| --- | --- |
| **Atoms Involved** | **Type of Bond** |
| 1. metal bonded to non-metal |  |
| 2. non-metal bonded to non-metal |  |
| 3. metal bonded to metal |  |

**Ionic Bonding**

* Ionic bonding occurs because of the electrostatic attractive force between the oppositely charged ions produced when a metal atom transfers one or more electrons to a non-metal atom.



Important Points:

1. Ionic compounds form between \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ whose electronegativity difference (ΔEN) exceeds \_\_\_\_\_\_\_\_. They typically form when metals from groups 1 or 2 react with non-metals from groups 16 or 17 of the periodic table.
2. During the formation of an ionic bond, metal atoms will \_\_\_\_\_\_\_\_\_\_\_\_\_\_ one or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons to the more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ non-metal atoms.

This occurs because the metal’s relatively low \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Ionic compounds form structures known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The vast number of attractive forces present in such lattices account for the high melting temperatures of ionic compounds.

**Practice 1:**

Write formulas for the ionic compounds form when the following elements combine:

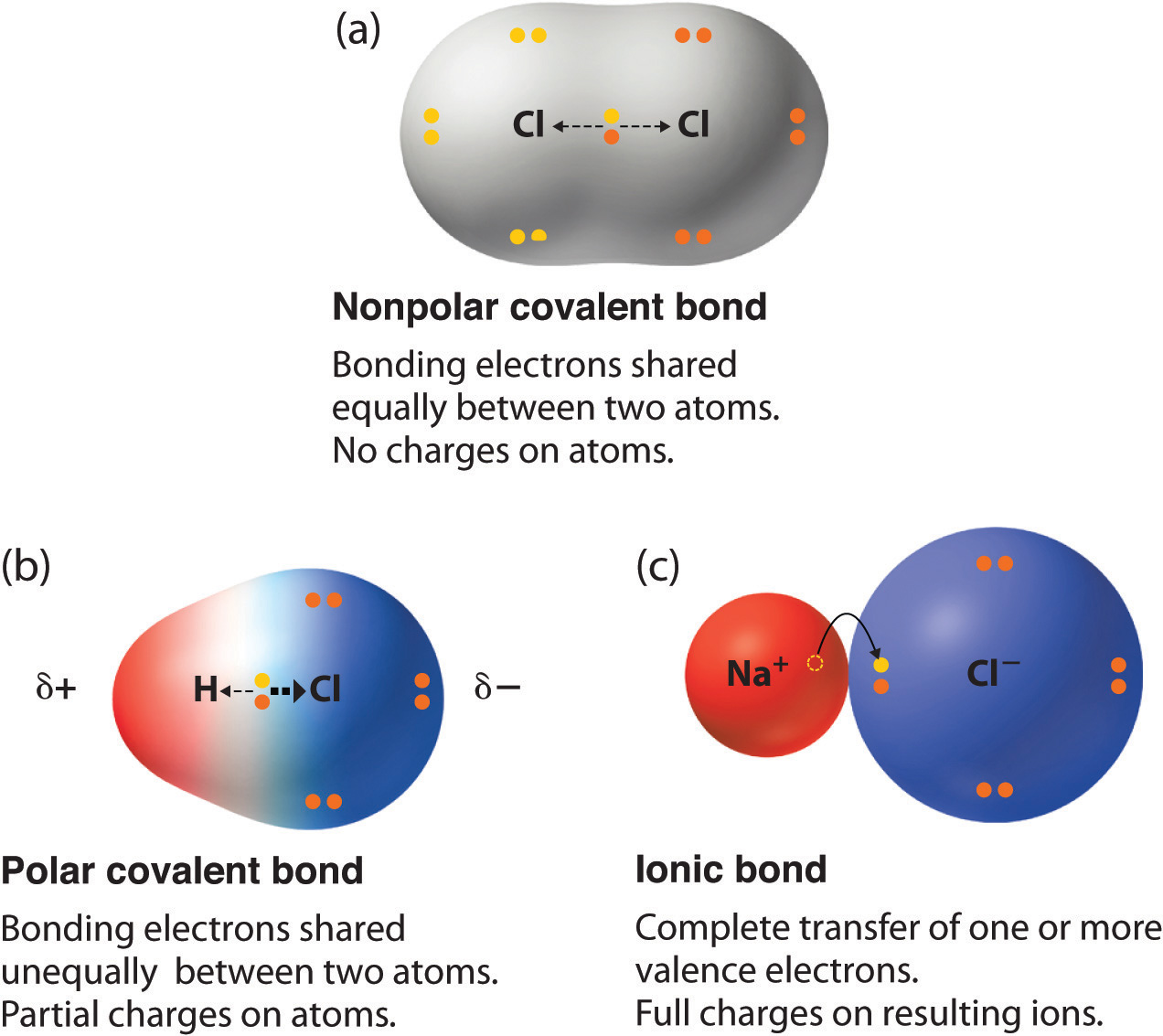
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) Ba and Br | b) Be and O | c) Sr and N | d) Mg and Cl | e) Fr and F |

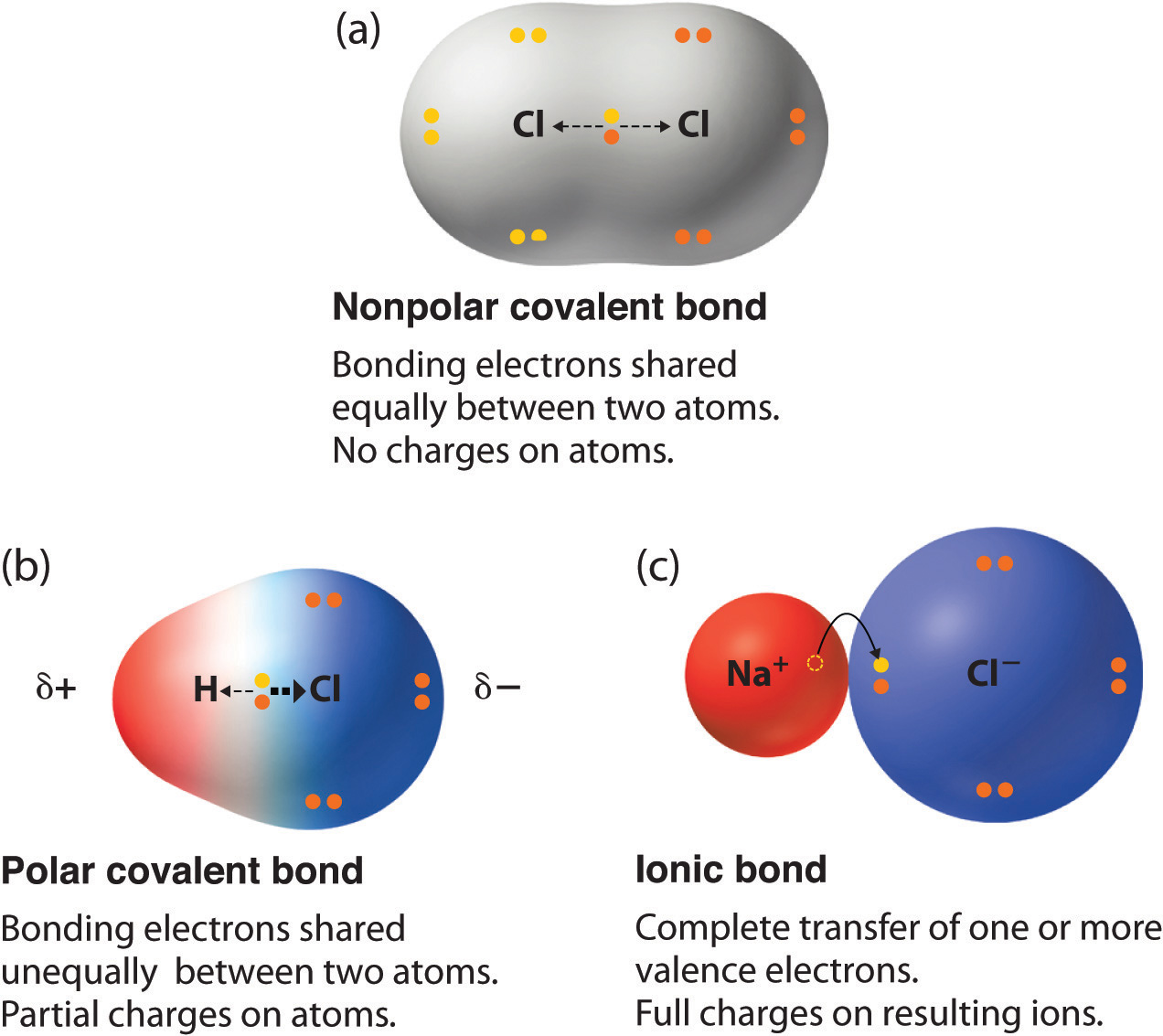
**Practice 2:**

Write formulas for the compounds formed when the following elements combine and justify that the bonds present are ionic by determining the ΔEN in each case.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) Ca and Br | b) Al and O | c) Be and O | d) Rb and N | e) Ba and Cl |

**Covalent Bonding**

* A bond formed from the sharing of electron pairs between atoms
* Can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Important Points:

1. Covalent compounds form between two ­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Because no electron transfer occurs and no ions form, all of the species prior to and following covalent bond formation between two atoms are electrically neutral.
3. The force of attraction in a covalent bond is between a pair of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and two adjacent positive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, rather than between a cation and an anion.

Electrons in covalent bonds are always associated in pairs.

1. Covalent compounds exist as independent molecules rather than large crystal structures.

|  |  |
| --- | --- |
| ΔEN | Bond Designation |
|  |  |
|  |  |
|  |  |
|  |  |

**Practice 1:**

Justify that the bonds present are covalent by determining the ΔEN in each case.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) N and F | b) C and H | c) Si and N | d) C and S | e) O and O |

**Practice 2:**

Calculate the ΔEN values for the bonds in the following compounds. Then arrange the compounds in order from those containing bonds in which the electrons are shared most equally to those in which the electrons are shared most unequally.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a) H2O | b) PCl3 | c) Cl4 | d) SiO2 | e) AlN |

**Practice 3:**

Complete the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Elements Present** | **Formula** | **ΔEN values** | **Nature of Bonds** | **Atom Possessing Greater Electron Density** |
| C and S |  |  |  |  |
| B and Cl |  |  |  |  |
| Al and O |  |  |  |  |
| N and I |  |  |  |  |
| Ca and F |  |  |  |  |

Does every metal & non-metal combination result in an ionic bond? Explain.