Section 2.3: Chemical Bonding and Electronegativity

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1. In the periodic table, electronegativity increases as one moves from left to right and from bottom to top. Atomic radius increases as one moves from right to left and from top to bottom.

2. In order of increasing electronegativity: Cs, K, Ca, Fe, Br, Cl, F.

3. In order to predict what type of bond will form in a compound, we need to find the electronegativity difference between the two elements involved. If the electronegativity difference is greater than 1.7, the bond will be ionic. If the electronegativity difference is between 0.5 and 1.7, the bond is polar covalent. If the electronegativity difference is below 0.5, the bond will be non-polar covalent.

4. A polar covalent bond is a covalent bond formed between atoms with significantly different electronegativities, thus resulting in a bond with localized positive and negative charges, or poles. A non-polar covalent bond is a covalent bond formed between atoms with identical (or very similar) electronegativities.

5. Electronegativity difference and type of bond formed between two elements:
   (a) Ca–S: ΔEN = 1.6, polar covalent
   (b) H–F: ΔEN = 1.8, ionic
   (c) P–H: ΔEN = 0, non-polar covalent
   (d) C–Cl: ΔEN = 0.6, polar covalent
   (e) C–O: ΔEN = 0.8, polar covalent
   (f) Li–Cl: ΔEN = 2.2, ionic

6. (a) H–F is a more polar bond than H–Cl.
   (b) O–H is a more polar bond than C–H.
   (c) C–N is a more polar bond than N–N.

7. (a) N2(g) has non-polar covalent bonds.
   (b) NH3(g) has non-polar covalent bonds.
   (c) H2O(l) has polar covalent bonds.
   (d) FeO(s) has polar covalent bonds.
   (e) MgCl2(s) has ionic bonds.

8. (a) The most ionic bond possible between any two elements in the periodic table is Fr–F, the bond that forms between an atom of francium, F, and an atom of fluorine, F. Fluorine has the highest electronegativity value of all the elements (4.0) and francium has the lowest (0.7), so the electronegativity difference between francium and fluorine (3.3) is the highest possible between two elements and thus Fr–F is the strongest ionic bond.
   (b) A compound that contains the Fr–F bond would exhibit strong ionic compound characteristics: it would have a very high melting point and boiling point, it would be soluble in water, and it would form an electrolyte.

9. Answers may vary depending on research. Students should discuss Linus Pauling’s work as a path-breaking chemist in the field of molecular structure and the nature of the chemical bond and as a social activist and educator.

10. Answers may vary depending on research. Students should explain Neil Bartlett’s accomplishments and that Bartlett’s work with inert gas compounds was one of the major Canadian discoveries in chemistry.