Whitehaven High – Grade Improvement Assignment – Honors Chemistry

Please send completed assignment to your teacher by 11:59 pm on May 11, 2020.

(Govan: govanm@scsk12.org Lucas: lucasjn@scsk12.org)

Student Name: ____ Date: ________________

A chemical bond is the physical phenomenon of chemical substances being held together by attraction of atoms to each other through both sharing and exchanging of electrons or electrostatic forces. Bond energy is a measure of bond strength in a chemical bond. For example, the carbon hydrogen (C–H) bond energy is the energy change involved with breaking up the bond between the carbon and hydrogen atoms. Bonds with a higher energy release more energy when they form and are considered to be more stable (less reactive).

When reacting with nonmetals, hydrogen forms covalent bonds, meaning that the bonded atoms share electrons with each other. Figure 1 shows the bond energies and distances for bonds involving hydrogen and nonmetals (H–X). The chart is arranged by period (rows of periodic table); in addition, the values for group 17 (column 17 on the periodic table) are compared.

Bond	Energy (kJ/mol)	Length (pm)
Period 1		
H–H	436	74
Period 2		
H–B	391	119
H–C	413	109
H–N	393	101
H–O	460	96
H–F	568	92
Period 3		
H–P	326	144
H–S	366	134
H–Cl	432	127
Period 4		
H–Se	279	146
H–Br	366	141
Group 17		
H–F	568	92
H–Cl	432	127
H–Br	366	141
H–I	298	161

Figure 1

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Bond length is the distance between two bonded atoms in a molecule. Bond lengths are measured in molecules by means of X-ray diffraction. A set of two atoms sharing a bond is unique going from one molecule to the next. For example, the oxygen to hydrogen bond in water is different from the oxygen to hydrogen bond in alcohol. It is, however, possible to make generalizations when the general structure is the same. Figure 2 relates bond energy to bond length for H–X bonds between hydrogen and nonmetals. The elements in each period or group are connected by a line (with the exception of the first, which contains only hydrogen).

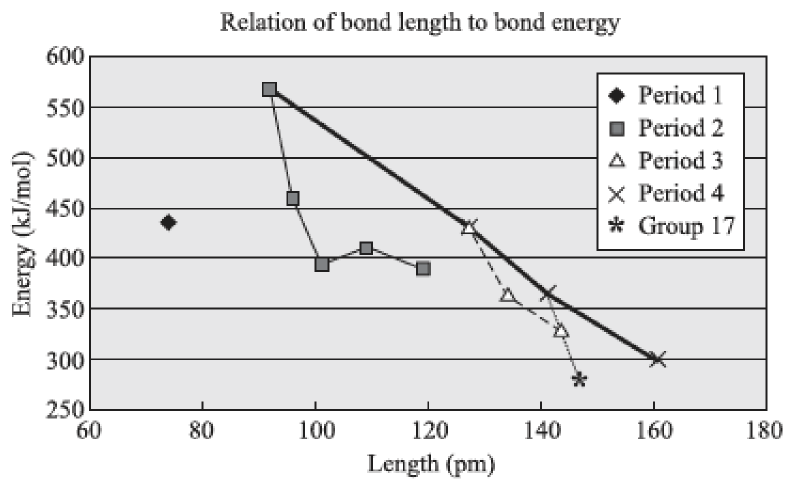

Figure 2

1. Suppose a certain experiment calls for a very stable substance with bond energy greater than 420 kJ/mol. Which of the following pairs of elements in a compound would yield a stable enough substance?

   A. H and C
   B. H and O
   C. H and P
   D. H and S

2. Generally speaking, the higher the bond energy, the more stable the bond is. The three most stable bonds shown in Figure 1 are:

   A. H–F, H–Cl, H–Br
   B. H–F, H–N, H–H
   C. H–F, H–O, H–H
   D. H–H, H–O, H–Cl

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3. Which of the following substances would have the highest sum of bond energies (for example, H_2O has two H–O bonds)?

A. H_2O
B. H_2S
C. NH_3
D. H_3Cl

4. Based on observations from Figures 1 and 2, which of the following statements is the best assessment of the data?

A. Hydrogen H–X bond energies decrease along a group and bond lengths increase along a group.
B. Hydrogen H–X bond energies increase along a group and bond lengths increase along a group.
C. Hydrogen H–X bond energies decrease along a group and bond lengths decrease along a group.
D. Hydrogen H–X bond energies decrease across a period and increase along a group.

5. Which of the following is the correct order for increasing bond lengths for bonds between these pairs of elements: H–O, H–S, H–Se?

A. H–Se > H–S > H–O
B. H–S > H–O > H–Se
C. H–S < H–O < H–Se
D. H–O < H–S < H–Se