ANSWER KEY.

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Bond Properties

Chemistry | ANSWER KEY

Draw Lewis structures when you need to find bond rank. Higher bond rank gives a shorter, stronger bond. Bigger atoms give a longer, weaker bond.

1. Give the bond rank of the carbon-carbon bond in ethane (C_2H_6), ethene (C_2H_4), and ethyne (C_2H_2). Then rank the three bonds from shortest to longest.

Ethane: C–C, rank 1. Ethene: C=C, rank 2. Ethyne: C≡C, rank 3. Shortest to longest: C≡C (ethyne) < C=C (ethene) < C–C (ethane)

2. Which bond is stronger, H–Cl or H–Br? Explain without using data.

H–Cl. Both are single bonds, and Cl is smaller than Br, so H–Cl is shorter and stronger.

3. Put these bonds in order of increasing bond length: H–S, H–O, H–Se.

H–O < H–S < H–Se. All are single bonds, and the atoms get bigger down group 16.

4. Use the data to answer. (a) Which bond has the highest bond energy? (b) Which has the lowest?

Bond	**C–N**	**C=N**	**C≡N**
Length (pm)	147	129	116

(a) C≡N, the shortest bond. (b) C–N, the longest bond. Shortest is strongest.

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5. Which has the longer carbon-oxygen bond, CO or CO_2? In CO, the carbon and oxygen atoms share three pairs of electrons. Explain.

CO_2. Its C=O bonds are double bonds (rank 2). CO has a triple bond (rank 3), which is shorter.

6. Which oxygen-oxygen bond is stronger: the bond in O_2, or the bond in hydrogen peroxide, H_2O_2 (atoms connected H–O–O–H)? Explain.

O_2. Its O=O bond is a double bond (rank 2). The O–O bond in H_2O_2 is a single bond (rank 1), so it is longer and weaker.

7. An O–H bond in water takes about 463 kJ/mol to break. A hydrogen bond between water molecules takes about 20 kJ/mol. When water boils, which one is overcome? Explain using these numbers.

The hydrogen bonds between molecules. They take far less energy (about 20 kJ/mol) than the O–H bonds (463 kJ/mol), so the molecules separate while the O–H bonds stay whole.

8. A student says the longest bond is the strongest because the atoms have more room. Correct the student.

It is the opposite. Shorter bonds are stronger. A long bond means the shared electrons are farther from the nuclei, so the bond is weaker and takes less energy to break.

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