Comparing Covalent Molecules and Ionic Molecules

How Covalent Molecules and Ionic Compounds are formed
Covalent molecules and ionic compounds are both composed of 2 or more atoms.
Ionic compounds are formed when a metal atom transfers its valence electrons to a non-metal atom. The metal and non-metal atoms develop + and – charges. When millions of ionic compounds bond together due to their + and – charges, they form crystals like the stalgmites and stalactites found in caves.

Covalent molecules are formed when non-metal atoms share valence electrons to completely fill their valence shells. Covalent molecules are considered to be neutral in charge.

Tricky Test Question:
*It is possible for one compound to have both ionic and covalent bonds. This happens if a metal forms an ionic compound with a polyatomic ion (see Table E) that is composed of non-metal atoms. *For example, $NaHCO_3$ is an ionic compound because Na is a metal that will give one electron to HCO_3, which is a polyatomic ion made of non-metal atoms.
<u>Test Strategy:</u> In this question type, look for a metal followed by more than one non-metal.

Physical Properties of Covalent Molecules vs. Ionic Compounds
Physical Properties are characteristics of elements and compounds that can be measured without changing the substance into a new substance. Examples are density, mass, melting point, and solubility.

Melting Point and Boiling Point

Covalent molecules do not stick together very well (they have weak intermolecular forces) because they do not have a + or – charge. Therefore, covalent molecules have relatively low melting points and low boiling points. Ionic compounds stick together because of their + and – charges (they have strong intermolecular forces). Therefore, ionic compounds have relatively high melting points and boiling points.

An important physical property is whether or not a substance conducts electricity. Many ionic compounds conduct electricity when they are dissolved in water, because their ions have + and – charges.

Bond Length and Strength of Single, double, and triple bonds
*Bond length describes the distance between the nuclei of two atoms that form a covalent bond.
*Bond strength describes how much energy it takes to break apart the covalent bond between two atoms.
*If atoms that can form single, double, or triple bonds, they bond length and strength will vary.
*The more bonds between two atoms, the shorter the bond length, and the higher the bond strength. If two carbon atoms have a triple covalent bond, the carbon atoms will be very close together and will be very difficult to break apart compared to two carbon atoms with only one covalent bond between them.

1) Which is an ionic compound?
(annotation: label elements as metals or non-metals)
(a) HCl (b) Au

(c) NaBr (d) CCl_4

2) Which is a covalent compound?
(annotation: label elements as metals or non-metals)
(a) $C_6H_{12}O_6$ (b) NaS

(c) KBr (d) O_2

3) Which has both ionic and covalent bonds?
(annotation: find a metal followed by more than one non-metal)
(a) HCl (b) NaCl

(c) KF (d) KPO_4

4) Using Table S, what is the density of gold (Au)?

5) Which type of compound, ionic compounds or covalent compounds, conducts electricity when dissolved in water?

6) The ethane gas, C_2H_6, is a covalent molecule with a single bond between its carbon atoms. Ethyne, C_2H_2, is a covalent molecule with a triple bond between its carbon atoms.

Do the carbon atoms in ethane or ethyne have a stronger bond?