

Chemistry Concepts Explained: Multiple Choice

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Response: The correct statement is **(5)**.

Detailed Analysis of Each Option

(1) Incorrect

- In SF_5^+ , the central sulfur atom has 5 valence electrons minus 1 for the positive charge, leaving 4 electrons. It forms 5 single bonds with fluorine atoms, using 5 bonding pairs and **0 lone pairs** on the central atom (steric number = 5).
- Both its **electron pair geometry** and its **molecular shape** are **trigonal bipyramidal**. Because there are no lone pairs on the central atom, the geometry and shape are identical.

(2) Incorrect

- Comparing the isoelectronic pair Mg^{2+} and F^- (both have 10 electrons):
 - Mg^{2+} has 12 protons pulling 10 electrons.
 - F^- has 9 protons pulling 10 electrons.
- Therefore, Mg^{2+} is smaller than F^- ($\text{Mg}^{2+} < \text{F}^-$). The order given starts with $\text{F}^- < \text{Mg}^{2+}$, which is incorrect.

(3) Incorrect

- Nitric acid (HNO_3) has **2 major resonance structures**, involving the delocalization of the double bond across the two non-protonated oxygen atoms ($\text{H-O-N(=O)-O}^- \longleftrightarrow \text{H-O-N(O}^-\text{)=O}$).

(4) Incorrect

- Comparing the C-O bond orders:
 - CO: Bond order = 3 (triple bond)
 - CO_2 : Bond order = 2 (double bond)
 - CO_3^{2-} : Bond order = 1.33 (resonance hybrid)
 - CH_3OH : Bond order = 1 (single bond)

- Bond length is inversely proportional to bond order. Thus, CH_3OH has the longest C-O bond, not CO_3^{2-} .

(5) Correct

- The electronegativity of an atom increases as the **s-character** of its hybridized orbitals increases (s-orbitals are closer to the nucleus and hold electrons more tightly):
 - CH_4 : Carbon is sp^3 hybridized (25% s-character)
 - COCl_2 : Carbon is sp^2 hybridized (33.3% s-character)
 - HCN : Carbon is sp hybridized (50% s-character)
- Therefore, the electronegativity of the carbon atom increases in the order:

