Valence Electron Configurations and States

https://gemini.google.com/app/e0a8c7402137d787

Response: **3.** $2s^2 2p^2$

Analysis of Options:

- **1.** $3d^4 4s^2 \rightarrow$ Chromium (Cr, ground state $3d^5 4s^1$) exhibits variable oxidation states including +2, +3, +4, +6.
- **2.** $2s^2 2p^4 \rightarrow$ Oxygen (O) primarily exhibits a valency of 2 (e.g., $\mathrm{H_2O}$). Due to the absence of vacant d-orbitals in the $n = 2$ shell, it cannot expand its octet to show a valency of 4.
- **3.** $2s^2 2p^2 \rightarrow$ Carbon (C) has 2 unpaired electrons in its ground state ($2s^2 2p_x^1 2p_y^1$), giving a valency of 2 (e.g., CO). Upon excitation ($2s^1 2p_x^1 2p_y^1 2p_z^1$), it forms 4 bonds, giving a valency of 4 (e.g., $\mathrm{CH_4}, \mathrm{CO_2}$). Lacking d-orbitals, it shows **only** 2 and 4.
- **4.** $3s^2 3p^4 \rightarrow$ Sulfur (S) can exhibit valencies of 2 ($\mathrm{H_2S}$), 4 ($\mathrm{SF_4}$), and 6 ($\mathrm{SF_6}$) due to available $3d$-orbitals.
- **5.** $3s^2 3p^1 \rightarrow$ Aluminum (Al) typically shows a valency of 3 ($\mathrm{AlCl_3}$).
