Ionization Energy Trend Explanation

https://gemini.google.com/app/c6d9ca763ca7c9eb

Response: The correct option is **(2)** $\mathrm{He} > \mathrm{H} > \mathrm{Be} > \mathrm{B} > \mathrm{Li} > \mathrm{Na}$.

Step-by-Step Breakdown

- $\mathrm{He} > \mathrm{H}$**:** Helium has a completely filled $1s^2$ shell with a higher effective nuclear charge ($Z = 2$) than Hydrogen ($1s^1$), giving it the highest first ionization energy among all elements ($2372\ \mathrm{kJ/mol}$ vs. $1312\ \mathrm{kJ/mol}$).
- $\mathrm{H} > \mathrm{Be}$**:** The electron in Hydrogen is in the $n = 1$ shell, which is much closer to the nucleus than the $n = 2$ valence shell of Beryllium ($899\ \mathrm{kJ/mol}$).
- $\mathrm{Be} > \mathrm{B}$**:** Beryllium ($1s^2 2s^2$) has a stable, fully-filled $2s$ subshell. Boron ($1s^2 2s^2 2p^1$) has its highest-energy electron in a $2p$ subshell, which is higher in energy and shielded by the $2s$ electrons, making it easier to remove ($899\ \mathrm{kJ/mol}$ vs. $801\ \mathrm{kJ/mol}$).
- $\mathrm{B} > \mathrm{Li}$**:** Across Period 2, effective nuclear charge increases from Li ($520\ \mathrm{kJ/mol}$) to B ($801\ \mathrm{kJ/mol}$).
- $\mathrm{Li} > \mathrm{Na}$**:** Down Group 1, atomic radius increases and inner-shell shielding increases, so Sodium's outer electron ($3s^1$) is held less tightly than Lithium's outer electron ($2s^1$) ($520\ \mathrm{kJ/mol}$ vs. $496\ \mathrm{kJ/mol}$).

Approximate IE_1 Values ($\mathrm{kJ/mol}$)

$$\mathrm{He}\ (2372) > \mathrm{H}\ (1312) > \mathrm{Be}\ (899) > \mathrm{B}\ (801) > \mathrm{Li}\ (520) > \mathrm{Na}\ (496)$$
