Electron Address Clues

Use periodic table positions to predict electrons and ion charges

CHE.3.3 "Analyze the periodic table to identify quantum numbers (e.g., valence shell electrons, energy level, orbitals, sublevels, and oxidation numbers)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB In paragraph 1, underline the sentence that links a period to an energy level and circle the two sentences that turn group numbers into valence-electron counts. In paragraph 3, box the three sentences that list common ion charges.

Reading an Atom's Address

1. A periodic table is a map of electron energy. For a neutral main-group atom, the period gives the number of its highest occupied energy level, called n. The outermost occupied level is its valence shell. In groups 1 and 2, the group number matches the number of valence electrons. In groups 13 through 18, subtract 10 from the group number to find that number, except helium has only two. Carbon, in period 2 and group 14, has four valence electrons in level 2. These shortcuts describe neutral main-group atoms, not every transition metal.

2. The s and p blocks show where the outer electrons go. An s sublevel contains one orbital, which holds at most two electrons; a p sublevel contains three orbitals, which hold at most six. For a main-group atom, put outer electrons into the s sublevel of its valence shell first, then into p. In level 2, carbon's four outer electrons fill $2s^2$ and leave $2p^2$. The two p electrons occupy separate p orbitals before either pairs up. Period 2 does not mean that every outer electron sits in a p orbital.

3. An atom's ion charge reveals whether it gained or lost electrons. Group 1 commonly loses one outer electron and forms a 1^+ ion; group 2 loses two and forms a 2^+ ion. Group 13 often loses three and forms a 3^+ ion. Group 16 commonly gains two and forms a 2^- ion; group 17 gains one and forms a 1^- ion. For a simple ion, its charge is also its oxidation number. Count valence electrons from the group, place them in sublevels using the period, then predict the common charge. Transition metals can have several oxidation numbers.

2 ANSWER WITH EVIDENCE

Use the passage

1. A neutral atom is in period 4, group 2. What is its highest occupied energy level, how many valence electrons does it have, and which outer sublevel holds them?

2. A neutral atom is in period 3, group 17. Write its outer s and p sublevel occupancies. How many p orbitals contain electrons?

3. A neutral atom is in period 3, group 16. Predict its common ion charge and explain your prediction using its valence-electron count.

4. A student says a period 4, group 1 atom has its valence electron in 4p because it is in period 4. What should the student change, and why?

3 YOUR TURN

Your own words

Compare lithium in period 2, group 1, with oxygen in period 2, group 16. For each, give its highest occupied energy level, valence-electron count, outer s and p sublevel occupancies, and likely ion charge; then explain why the charge signs differ.

Electron Address Clues

PART 1 · READ AND MARK

In paragraph 1, underline the sentence that links a period to an energy level and circle the two sentences that turn group numbers into valence-electron counts. In paragraph 3, box the three sentences that list common ion charges. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A neutral atom is in period 4, group 2. What is its highest occupied energy level, how many valence electrons does it have, and which outer sublevel holds them?	**Its highest occupied level is 4. It has two valence electrons, both in $4s^2$.**
2	A neutral atom is in period 3, group 17. Write its outer s and p sublevel occupancies. How many p orbitals contain electrons?	**Its outer arrangement is $3s^2 3p^5$. All three p orbitals contain electrons.**
3	A neutral atom is in period 3, group 16. Predict its common ion charge and explain your prediction using its valence-electron count.	**It has six valence electrons and commonly gains two, forming a 2^- ion.**
4	A student says a period 4, group 1 atom has its valence electron in 4p because it is in period 4. What should the student change, and why?	**The electron is in $4s^1$, not 4p. The period identifies level 4, and the s sublevel fills before p.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Lithium's highest occupied level is 2. It has one valence electron in $2s^1$, no electrons in 2p, and commonly forms Li^+. Oxygen's highest occupied level is also 2. It has six valence electrons in $2s^2 2p^4$ and commonly forms O^{2-}. Their charge signs differ because lithium loses an electron, while oxygen gains two.

Accept equivalent sublevel descriptions and charge notation. The comparison should distinguish lithium's electron loss from oxygen's electron gain.