



Monoatomic vs. Polyatomic Ions

Ions are atoms that have either lost or gained electrons. While atoms are neutral, ions are charged particles. A loss of electrons results in a positive ion or cation (pronounced "cat-eye-on"). A gain of electrons results in a negative ion or anion (pronounced "an-eye-on").

Monatomic Ions. Composed on only one type of atom. In order to determine the charge of monatomic ions, you can use the periodic table as a guide. (In most cases, the charge of a monatomic anion is equal to the group number minus 8.) In order to determine the name of monoatomic ions, you must first determine if it is a cation or anion. Cations are named by saying the element and adding the word "ion." Anions are named by dropping the ending off the element name and adding "ide."

Polyatomic ions. "Poly" means many. Ions are particles with a positive or negative charge. So polyatomic ions are groups of (many) two or more atoms that have a charge. The group as a whole shares the charge. Most polyatomic ion's names end in "-ate" some end in "-ite". Only a few end in "-ide". Most polyatomic ions are negative.

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- | | |
|--|---|
| Ions that consist of a single atom are called <u> 1 </u> ions. | 1. <u> monoatomic </u> |
| Metallic elements tend to <u> 2 </u> electrons. Group 1A ions have a | 2. <u> lose </u> |
| <u> 3 </u> charge, whereas Group 2A metals form ions with a <u> 4 </u> | 3. <u> +1 </u> |
| charge, and Group 3A metals form ions with a <u> 5 </u> charge. | 4. <u> +2 </u> |
| The charge of a Group A nonmetal ion is determined by | 5. <u> +3 </u> |
| subtracting <u> 6 </u> from the group number. For example, the | 6. <u> 8 </u> |
| Group 7A elements form ions with a charge of <u> 7 </u> . | 7. <u> -1 </u> |
| Many of the <u> 8 </u> have more than one common ionic | 8. <u> B group/transition metals </u> |
| charge. These ions are named using either the <u> 9 </u> system | 9. <u> Stock (roman numeral) </u> |
| or the <u> 10 </u> naming system. | 10. <u> IUPAC/classical </u> |
| Ions containing more than one atom are called <u> 11 </u> ions. | 11. <u> polyatomic </u> |
| The names of most common polyatomic ions end in either | 12. <u> ate </u> |
| <u> 12 </u> or <u> 13 </u> . | 13. <u> ite </u> |

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- ST 14. The names of polyatomic ions end in *-ite* or *-ate*.
- AT 15. In polyatomic ions for which there is an *-ite/-ate* pair, the *-ite* ending will always indicate one less oxygen atom than the *-ate* ending.
- ST 16. Polyatomic ions are anions.
- NT 17. The charge on Group A metal ions is determined by subtracting the group number from 8.
- AT 18. The Group 6A ions have a charge of 2−.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

- | | |
|--------------------------------------|---|
| <u>B</u> 19. monatomic ions | a. negatively charged ions |
| <u>E</u> 20. polyatomic ions | b. ions formed from single atoms |
| <u>D</u> 21. cations | c. a traditional way of naming transition metal cations |
| <u>A</u> 22. anions | d. positively charged ions |
| <u>C</u> 23. classical naming system | e. ions formed from groups of atoms |

Part D Questions and Problems

Answer the following in the space provided.

24. What is the charge on a typical ion for each of the following groups?

- | | | | |
|-------|-----------|-------|-----------|
| a. 1A | <u>+1</u> | c. 7A | <u>-1</u> |
| b. 6A | <u>-2</u> | d. 2A | <u>+2</u> |

25. Write the name of each of the following polyatomic ions.

- | | | | |
|---------------------|---------------------------|---------------------|---------------------|
| a. HCO_3^- | <u>hydrogen carbonate</u> | c. MnO_4^- | <u>permanganate</u> |
| b. NH_4^+ | <u>ammonium</u> | d. OH^- | <u>hydroxide</u> |

26. How many electrons does the neutral atom gain or lose to form each of the following ions?

- | | | | |
|---------------------|---------------|---------------------|---------------|
| a. Ca^{2+} | <u>lose 2</u> | c. I^- | <u>gain 1</u> |
| b. S^{2-} | <u>gain 2</u> | d. Mn^{3+} | <u>lose 3</u> |