Answers to Extra Valence Configuration Problem
Chapter 6

Question: Give the valence configuration of each of the following, and also represent the configuration using line-and-arrow notation; e.g., ¼¿ : Na, Fe, Cu, In, As.

Answers:

Na $3s^1$ ¼ (3*s*)

Fe $3d^6 4s^2$ ¼¿ ¼ ¼ ¼ ¼ ¼ ¼¿ (3*d*) (4*s*)

Cu $3d^{10} 4s^1$ ¼¿ ¼¿ ¼¿ ¼¿ ¼¿ ¼ (3*d*) (4*s*)

In $5s^2 5p^1$ ¼¿ ¼ (5*s*) (5*p*)

As $4s^2 4p^3$ ¼¿ ¼ ¼ ¼ (4*s*) (4*p*)

(See the note on valence configurations on the following page.)

Note on Valence Configurations

The valence configuration is the configuration of the outermost electrons, which are involved in chemical bonding. This is not always the same as the configuration beyond the noble-gas core, particularly for elements for which $Z > 30$. For example, in noble-gas core notation the configuration of Sb is [Kr]$5s^2 4d^{10} 5p^3$. Any chemist would say Sb has five valence electrons, not fifteen! The $4d^{10}$ electrons are not counted as valence electrons, because they are not involved in ion formation or molecular bond formation. Despite the order of filling in the aufbau scheme, the 4*d* subshell lies below the 5*s* and 5*p* subshells. Note that writing $4d^{10}$ between $5s^2$ and $5p^3$ (in aufbau order) encourages the error of thinking that the $4d^{10}$ electrons are involved in chemical bonding. Written in shell order ($4d^{10}5s^2 5p^3$), it is easier to see that the valence configuration is $5s^2 5p^3$. This is the same pattern as other elements in Group 5A(15) (i.e., N, P, As, Bi), all of which have valence configurations $ns^2 np^3$. Use the following general patterns for valence configurations:

Block	Type	Valence Configuration
s	Groups 1A & 2A	ns^x (x = 1, 2)
p	Nonmetals (Groups 3A - 8A)	$ns^2 np^x$ (x = 1 - 6)
d	Transition metals	$(n\text{-}1)d^x ns^y$ (x = 1 - 10; y = 0 - 2)
f	Lanthanides/Actinides	$(n\text{-}2)f^x ns^y$ (x = 1 - 14; y = 0 - 2)