Warm Up:

1.How many electrons (maximum) can be found in the third energy level? (n = 3)

2. How many electrons (maximum) can be found in the d-atomic orbitals of an energy level?

Objectives:

TSWBAT:

Write ground state electron configurations for atoms.

Def: Electron Configuration: the ways in which electrons are arranged in various orbitals around the nuclei of atoms.

There are three rules for determining the electron configuration of a given atom:

1. The Aufbau Principle
2. The Pauli Exclusion Principle
3. Hund's Rule of Maximum Multiplicity

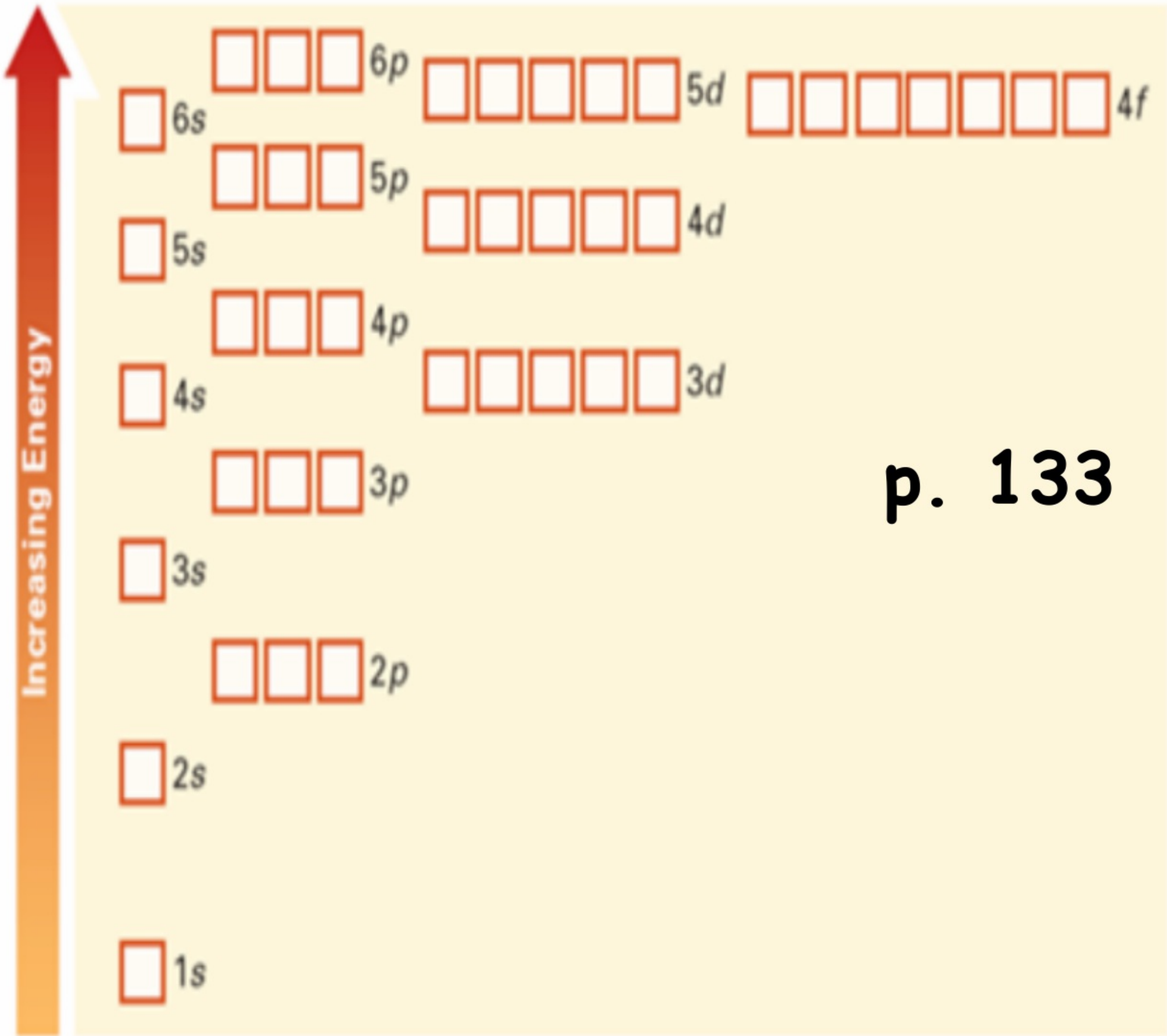
A word first about notations of the atomic orbitals.

People got tired of drawing the sphere for the s-orbital and the dumbells for the p-orbitals, etc. Since we all know each orbital holds at MOST 2 electrons, scientists began substituting a box for the orbital and just labeling the box "1s" or "2s" or "4p", etc.

Aufbau Principle

According to the aufbau principle, electrons occupy the orbitals of lowest energy first. Each box in the aufbau diagram represents an atomic orbital.

The term "aufbau" is the German word for "building up."



p. 133

Pauli Exclusion Principle

According to the Pauli exclusion principle, an atomic orbital may describe at most two electrons. To occupy the same orbital, two electrons must have opposite spins; that is, the electron spins must be paired.

We use up arrows for one spin and down arrows for the opposite spin.

Hund’s Rule

Hund's Rule states that electrons will spread out within a given energy level first. They will only pair up if there is already one electron in each atomic orbital of the same energy.

Look at the p-orbitals. It's like a doctor's waiting room.

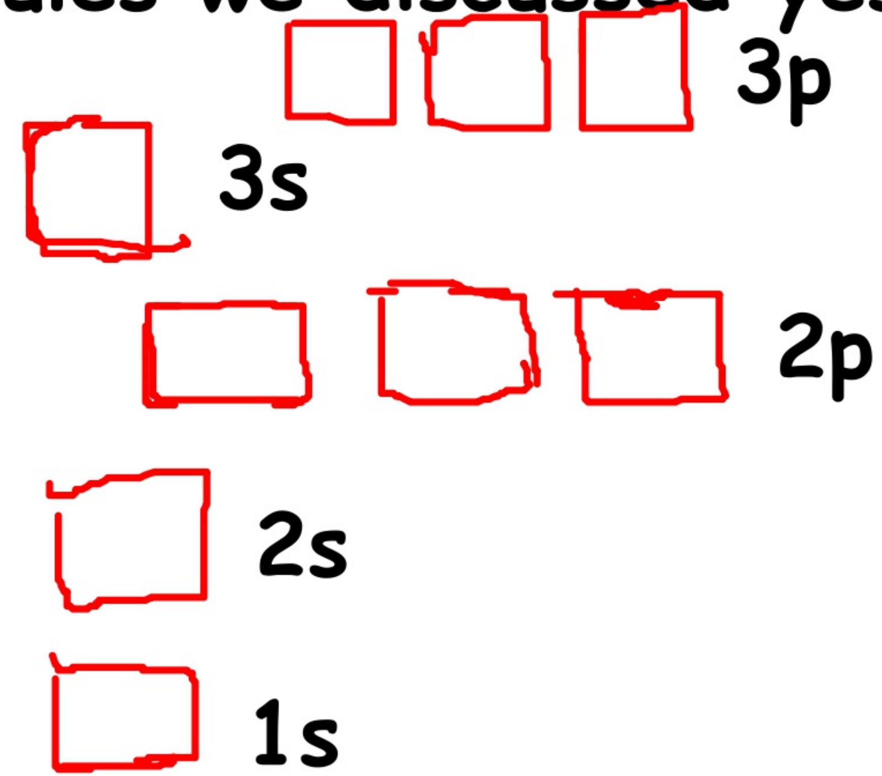
Table 5.3

Electron Configurations for Some Selected Elements

Element	Orbital filling						Electron configuration
	1s	2s	$2p_x$	$2p_y$	$2p_z$	3s	
H	↑						$1s^1$
He	↑↓						$1s^2$
Li	↑↓	↑					$1s^2 2s^1$
C	↑↓	↑↓	↑	↑			$1s^2 2s^2 2p^2$
N	↑↓	↑↓	↑	↑	↑		$1s^2 2s^2 2p^3$
O	↑↓	↑↓	↑↓	↑	↑		$1s^2 2s^2 2p^4$
F	↑↓	↑↓	↑↓	↑↓	↑		$1s^2 2s^2 2p^5$
Ne	↑↓	↑↓	↑↓	↑↓	↑↓		$1s^2 2s^2 2p^6$
Na	↑↓	↑↓	↑↓	↑↓	↑↓	↑	$1s^2 2s^2 2p^6 3s^1$

Warm Up

Using your Aufbau diagram, fill in the electrons for magnesium. Follow the 3 rules we discussed yesterday.



Ground State vs. Excited State

<u>Ground State</u> is just the normal, lowest energy state electrons usually occupy in a given atom.

<u>Excited State</u> is when energy has been added to the atom and the electrons have been promoted to higher energy levels than normal.

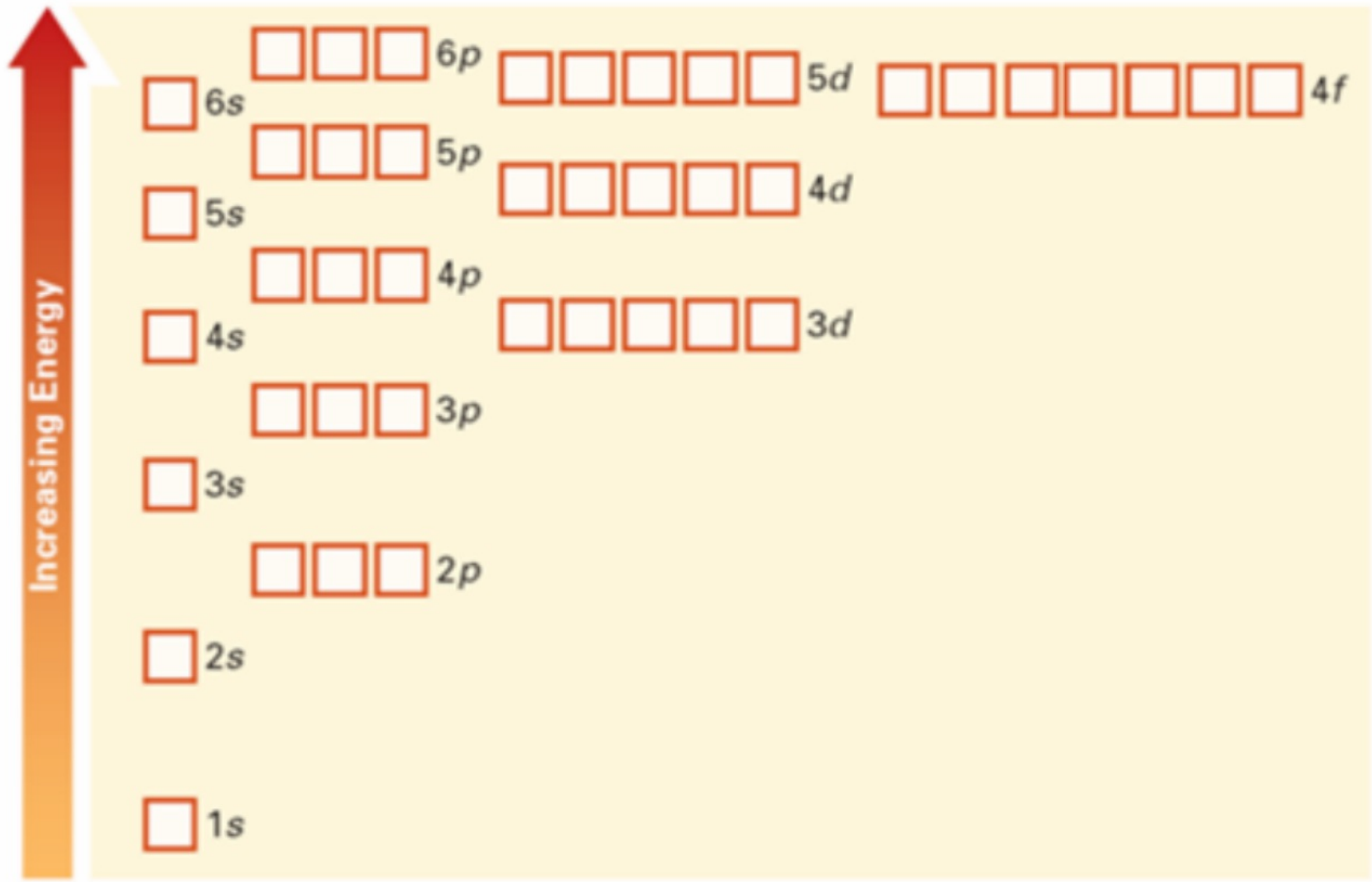
Please read before Friday, Feb 14:
pp. 138-139
pp. 141-143

(This will help you to understand the lab we are doing that day.)

(You can wear any shoes you want on Friday the 14th- there is no chemical hazard.)

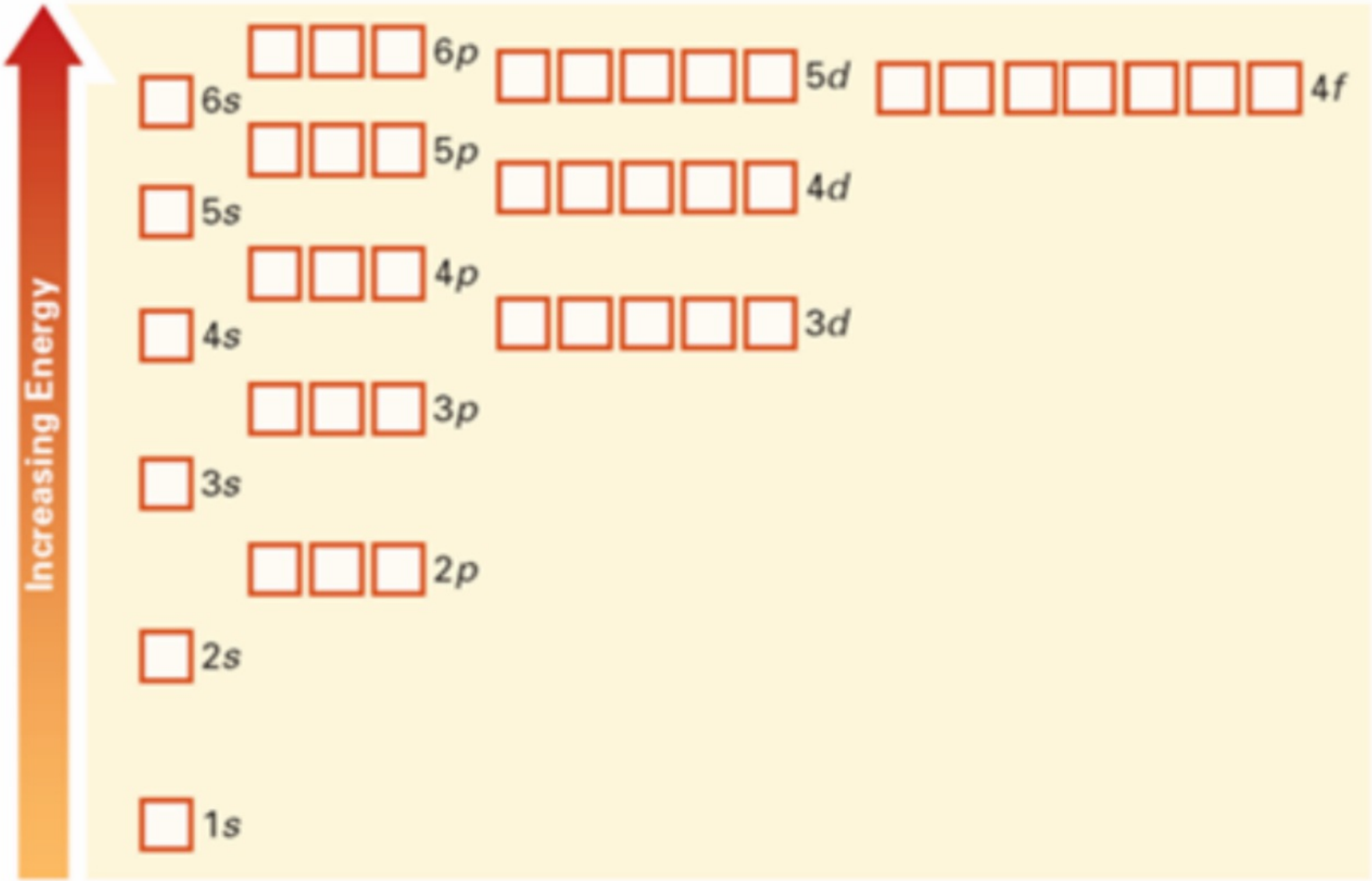
Warm Up

Use the aufbau diagram to write the electron configuration of aluminum.



Use the aufbau diagram below to draw the electron configurations of:

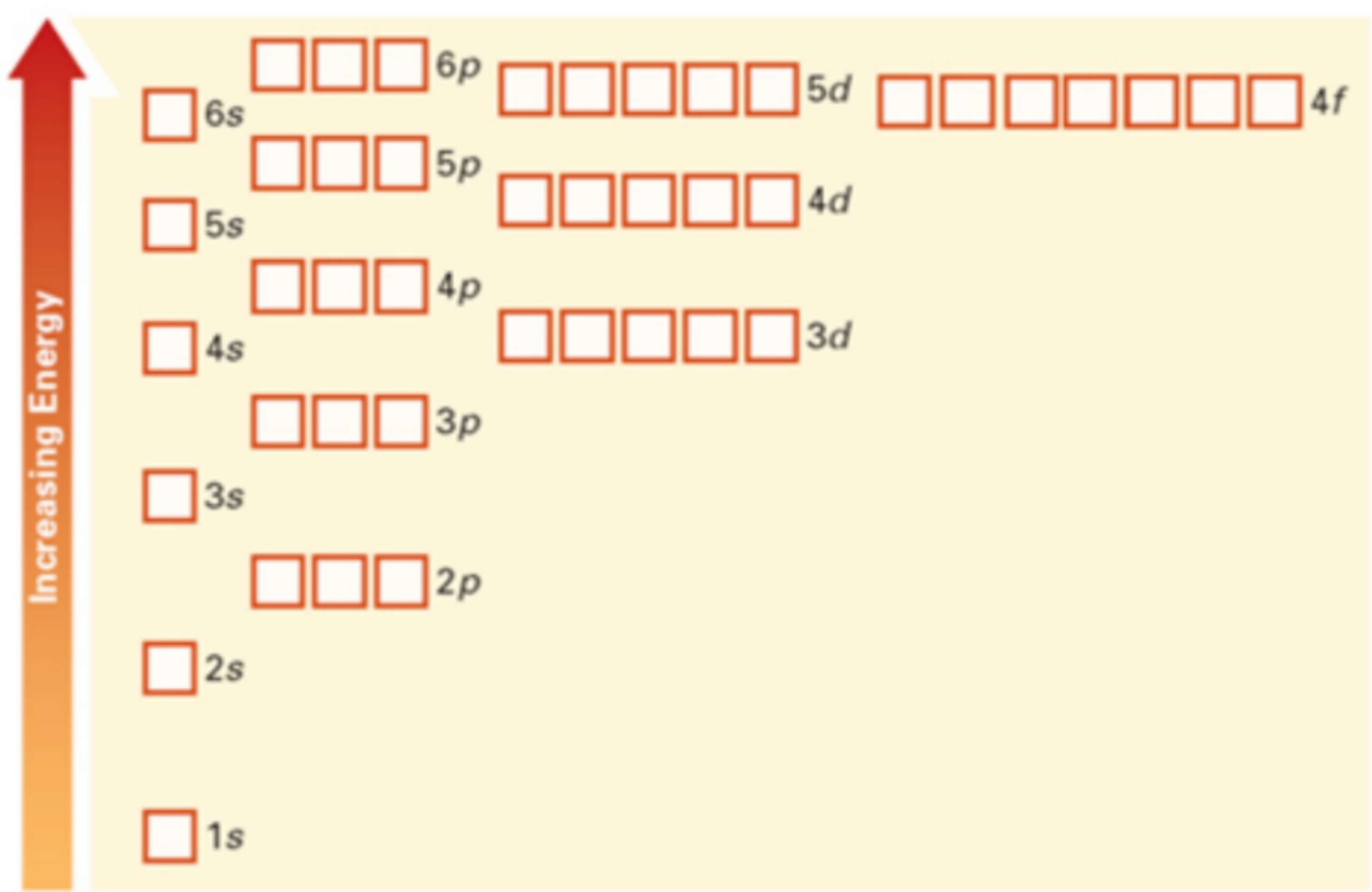
1. carbon
2. sodium
3. neon



Scientists quickly became tired of drawing the entire Aufbau diagram, so they started a short cut. If the first box (1s) had 2 electrons, they wrote "$1s^2$" This does NOT mean "s-squared"; it means the 1s orbital has 2 electrons. Let's try this short-hand for Lithium & Fluorine.

Write the electron configuration for each atom. How many unpaired electrons does each atom have?

a. boron   b. silicon



Warm Up

Write the short hand electron configuration of phosphorus. Use the Aufbau diagram on p. 133 of your textbook to help you.

Identify the element that corresponds to the following electron configuration: $1s^2 2s^2 2p^5$

$= 9e^-$

$= 9p^+$

fluorine

Warm Up
Write the electron configuration of bromine.

Objectives: TSWBAT
interpret electron configurations and trends in the periodic table.

PRACTICE

p. 135 #8 (b & c only)

Text book problems on
p. 150 # 50-53,57, 61, 68

Exceptions to the Aufbau Rule

Sometimes it pays to break the rules! Certain elements will break the Aufbau rule because doing so will allow that element to be more stable. A half-filled (or fully filled) set of orbitals is more stable than other arrangements. Let's look at copper, atomic number 29.

According to the Aufbau principle, copper should have the electron configuration:

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$

However, copper actually has the electron configuration:

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

It has broken the Aufbau rule to get a full set of d-electrons.

Another example is Chromium, atomic number 24. We would expect:
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$

Instead, chromium does this:
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$

By breaking the Aufbau rule, Cr gets a half-filled set of d-orbitals, which is more stable than following the rule!

Try predicting the exceptional electron configuration of the following:

Mo

Pd

Au