# AP WORKSHEET 01E: Orbital filling rules

The rules that you have been applying in order to determine the electronic configuration of an atom are summarized below.

**A**. Lowest energy orbitals are filled first. **THE AUFBAU PRINCIPLE**.

**B**. Orbitals can only contain a maximum of two electrons and when two electrons enter the same orbital they must have opposite spins (+ ½ or – ½) so that each electron has a unique set of quantum numbers. (In the electrons in boxes diagram they must be drawn ↑↓ **NOT** ↑↑ **OR** ↓↓). **THE PAULI EXCLUSION PRINCIPLE**.

**C**. When orbitals of identical energy (degenerate) are available electrons enter these orbitals singly before any spin pairing takes place. **HUNDS RULE**.

Consider each of the elements listed and the INCORRECT electronic configuration associated with each one. In each case identify which of the above rules or principles (**A**, **B** or **C**) is violated and insert the correct electronic configuration (*in a similar format to that of the incorrect configuration*). An example is completed for you. (34)

| ELEMENT | INCORRECT CONFIGURATION | VIOLATION | CORRECT CONFIGURATION |
|---|---|---|---|
| **N** | **$1s^2\ 2s^2\ 2px^2\ 2py^1$** | **C** | **$1s^2\ 2s^2\ 2px^1\ 2py^1\ 2pz^1$** |
| Al | $1s^2\ 2s^2\ 2p^6\ 3p^3$ | | |
| B | $1s^2\ 2s^3$ | | |
| P | $1s^2\ 2s^2\ 2p^6\ 3p^5$ | | |
| Mg | [Ne] ↑↑ | | |
| C | $1s^2\ 2s^1\ 2px^1\ 2py^1\ 2pz^1$ | | |
| C | $1s^2\ 2s^2\ 2px^2$ | | |
| Mn | [Ar] $4s^1\ 3d^6$ | | |
| Ni | [Ar] $4s^2\ 3d_{xy}^2\ 3d_{xz}^2\ 3d_{yz}^2\ 3d_{z2}^2\ 3d_{x2-y2}^0$ | | |
| Cl | [Ne] ↓↓ ↑↑ ↓↓ ↑ | | |
| Sc | [Ar] $3d^3$ | | |
| B | $1s^2\ 2s^1\ 2px^1\ 2py^1$ | | |
| Na | $1s^1\ 2s^2\ 2p^6\ 3s^2$ | | |
| S | [Ne] $3s^2\ 3px^2\ 3py^2$ | | |
| V | [Ar] $3d^5$ | | |
| P | [Ne] $3s^2\ 3px^2\ 3py^1$ | | |
| Kr | [Ar] $4s^2\ 3d^{16}$ | | |