

Quiz 8.3 - Atomic Spectroscopy

Name: Key

Electronic Term Symbols

Give the symbol for the lowest energy term for each of the following electronic configurations (You may neglect spin-orbit coupling and J -levels):

Cl: [Ne] $3s^2 3p^5$

$$\begin{array}{ccc} \frac{1}{-1} & \frac{1}{0} & \frac{1}{1} \end{array} \quad L=1 \quad S=\frac{1}{2} \rightarrow {}^2P$$

C: [He] $2s^2 2p^2$

$$\begin{array}{ccc} \frac{1}{-1} & \frac{1}{0} & \frac{1}{1} \end{array} \quad L=1 \quad S=1 \rightarrow {}^3P$$

Ti: [Ar] $4s^2 3d^2$

$$\begin{array}{ccccc} \frac{1}{-2} & \frac{1}{-1} & \frac{1}{0} & \frac{1}{1} & \frac{1}{2} \end{array} \quad L=3 \quad S=1 \rightarrow {}^3F$$

Si: [Ne] $3s^1 3p^2 4p^1$

$$\begin{array}{ccc} \frac{1}{0} & \frac{1}{-1} & \frac{1}{0} \end{array} \quad \begin{array}{ccc} \frac{1}{-1} & \frac{1}{0} & \frac{1}{1} \end{array} \quad L=2 \quad S=2 \rightarrow {}^5D$$

Nd: [Xe] $6s^2 4f^4$

$$\begin{array}{ccccccc} \frac{1}{-3} & \frac{1}{-2} & \frac{1}{-1} & \frac{1}{0} & \frac{1}{1} & \frac{1}{2} & \frac{1}{3} \end{array} \quad L=6 \quad S=2 \rightarrow {}^5I$$

Spin-Orbit Coupling

For each term, give the J states according Russell-Saunders coupling

○ 3P

$${}^3P_2 \quad {}^3P_1 \quad {}^3P_0$$

○ 2S

$${}^2S_{1/2} \quad (\text{no splitting})$$

○ 1D

$${}^1D_2 \quad (\text{no splitting})$$

○ 3F

$${}^3F_4 \quad {}^3F_3 \quad {}^3F_2$$

Selection Rules

Tell whether each transition (or class of transitions) is allowed. If not, give the selection rule which it violates

○ $1s^1 \rightarrow 2s^1$ Forbidden $\Delta l = \pm 1$

○ $1s^2 2s^2 2p^2 \rightarrow 1s^1 2s^2 2p^3$ Allowed

○ $^3P_2 \rightarrow ^3S_1$ Allowed

○ $^1D_2 \rightarrow ^3P_2$ Forbidden $\Delta S = 0$

○ $^3D_1 \rightarrow ^3S_1$ Forbidden $\Delta L = 0, \pm 1$

○ $^1P_0 \rightarrow ^1D_0$ Forbidden $J=0 \nrightarrow J=0$