35. For a given value of the principal quantum number $n$, there are $n$ possible values of the orbital quantum number $\ell$, ranging from 0 to $n-1$. For any value of $\ell$, there are $2\ell+1$ possible values of the magnetic quantum number $m_\ell$, ranging from $-\ell$ to $+\ell$. Finally, for each set of values of $\ell$ and $m_\ell$, there are two states, one corresponding to the spin quantum number $m_s = -\frac{1}{2}$ and the other corresponding to $m_s = +\frac{1}{2}$. Hence, the total number of states with principal quantum number $n$ is

$$N = 2\sum_{0}^{n-1}(2\ell+1) \ .$$

Now

$$\sum_{0}^{n-1} 2\ell = 2\sum_{0}^{n-1} \ell = 2\frac{n}{2}(n-1) = n(n-1) \, ,$$

since there are $n$ terms in the sum and the average term is $(n-1)/2$. Furthermore,

$$\sum_{0}^{n-1} 1 = n \ .$$

Thus $N = 2\left[n(n-1)+n\right] = 2n^2$.