

is an important quantity because the resultant torque on a system equals the rate of change of the total angular momentum, and in the case of central forces, the total angular momentum is conserved. For a classical system, the magnitude of the total angular momentum J can have any value between $L + S$ and $|L - S|$. We have already seen that in quantum mechanics, angular momentum is more complicated; both L and S are quantized and their relative directions are restricted. The quantum-mechanical rules for combining orbital and spin angular momenta or any two angular momenta (such as for two particles) are somewhat difficult to derive, but they are not difficult to understand. For the case of orbital and spin angular momenta, the magnitude of the total angular momentum J is given by

$$|\mathbf{J}| = \sqrt{j(j+1)}\hbar \quad 7-53$$

where the *total angular momentum quantum number* j can be either

$$j = l + s \quad \text{or} \quad j = |l - s| \quad 7-54$$

