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$$A + B \rightleftharpoons AB$$

$$\frac{n_A n_B}{n_{AB}} \propto \frac{q_A q_B}{q_{AB}}$$

- understandable, population proportional to Boltzmann weighted sum over states available.

$$K_{vJ} \propto n_{AB}(v,J)\, f_{vJ} = n_{AB} \underbrace{\frac{(2J+1)\, e^{-\epsilon_{vJ}/kT}}{q_{AB}}}_{\text{relative weight of initial state to total part funct.}} f_{vJ}$$

but can write $\frac{n_{AB}}{q_{AB}} \propto \frac{n_A n_B}{q_A q_B}$.

i.e. total occupied states relative to availability is related for molecule + atoms (modified by a zero point energy correction and mass correction to translational parts)

so can write
$$K \propto \frac{n_A n_B}{q_A q_B}.$$

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But we'll still need K, equilibrium constant to calculate n_A & n_B in a molecular equilibrium calculation.