Statistical Mechanics
Energy level diagram

$q_{vib}$
What is the probability of a CO molecule being in the \( \nu=0 \) vibrational state at 300 K.

- A \( \quad 0.0 - 0.19 \)
- B \( \quad 0.20 - 0.39 \)
- C \( \quad 0.40 - 0.59 \)
- D \( \quad 0.60 - 0.79 \)
- E \( \quad 0.80 - 1.00 \)
\[ q_{\text{rotational}} \]

- \( q_{\text{trans}} \)

- Replace sum with integral
Characteristic temperature

- Define a rotational temperature

- Define a vibrational temperature
Iclicker

What fraction of CO molecules are in the ground rotational state? \( B = 5.79 \times 10^{10} \) Hz

- A – 0.0 – 0.19
- B – 0.20 – 0.39
- C – 0.40 – 0.59
- D – 0.60 – 0.79
- E – 0.80 – 1.00
Maximum J

- Rotational state, J, with maximum fractional population.
Total partition function

\[ \ln Q \]
\[ Q \]

\[ \langle E \rangle \]
$\begin{bmatrix} Q \\ C_v \end{bmatrix}$
\[ \langle Q \rangle \]