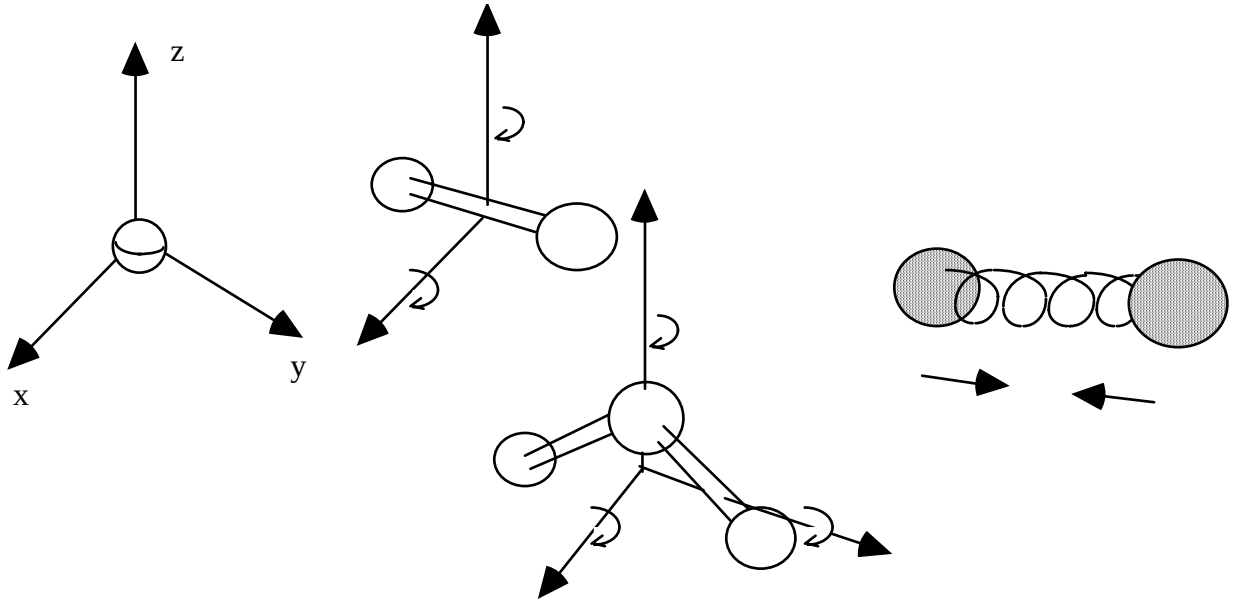
Equipartition Theorem

Goal Predict ΔU and C_V for gases

translation rotation vibration



kinetic only $\frac{p^2}{2m}$ kinetic only $\frac{J^2}{2I}$ kinetic and potential $\frac{p^2}{2m} + \frac{1}{2} kx^2$

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monatomic gas experimental $\Delta U = 3/2\ RT$ or $C_V = \left(\frac{\partial U}{\partial T}\right)_V = 3/2R$

1/2 R for each quadratic term in the energy

Number of Vibrations: Linear Molecules

3N	-	3	-	2	=	3N-5
total coordinates		specify center of mass		rotation: linear molecules		

Non-linear 3N – 6 vibrations

Heat Capacity Predictions from Equipartition, C_v.

Molecule	translation	rotation	vibration	total	total – vib	experiment	experiment
Ar	3/2R			3/2R	3/2R	12.5 J/K	3/2R
N_2	3/2R	2/2R	2/2R	7/2R	5/2R	20.8	5/2R
Cl_2	3/2R	2/2R	2/2R	7/2R	5/2R	25.6	6/2R
O_3	3/2R	3/2R	3(2/2R)	12/2R	6/2R	30.9	7.4/2R
H_2O	3/2R	3/2R	3(2/2R)	12/2R	6/2R	25.3	6.1/2R