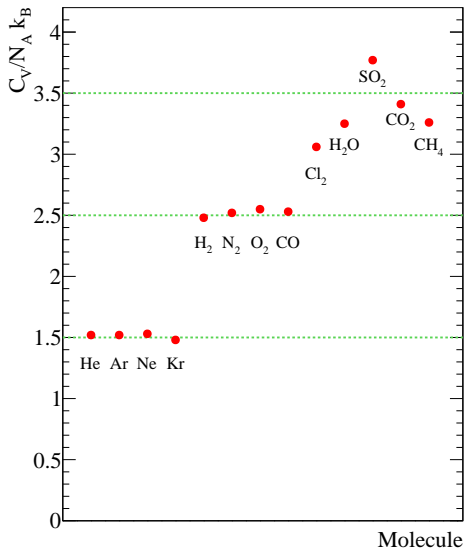
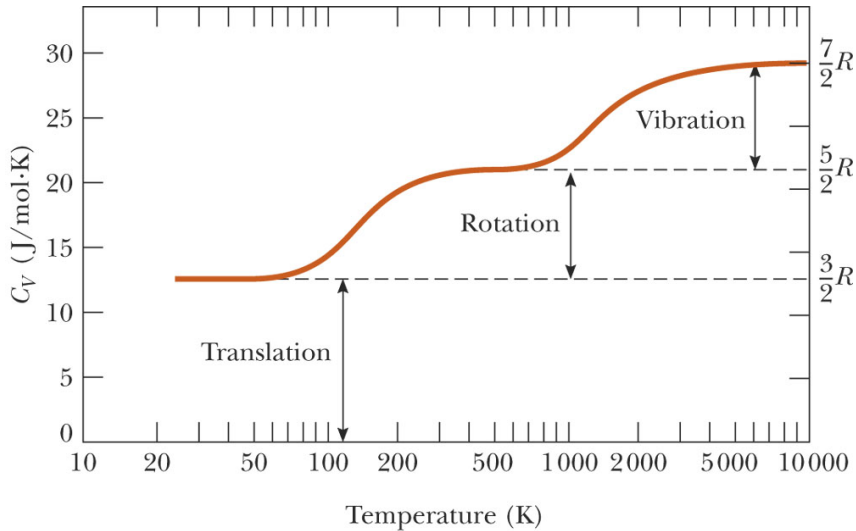


Recall A Hint of Quantum Mechanics



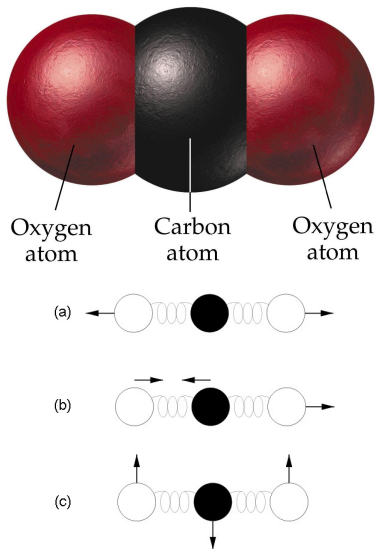
Recall A Hint of Quantum Mechanics



Why Is CO₂ a Greenhouse Gas?

The Earth is warming and the likely cause is the increase in greenhouse gases like carbon dioxide (CO₂) in the atmosphere. Carbon dioxide is a linear, tri-atomic molecule with a central carbon atom. The harmonic vibrations of CO₂ give it its absorption properties.

The vibrations of CO₂ can be described by a small set of 'normal modes' shown [here](#). If a normal mode distorts the symmetry of the charge distribution of the molecule, then it will acquire an electric dipole moment and can absorb light in the infrared range - preventing that light from passing through the atmosphere.

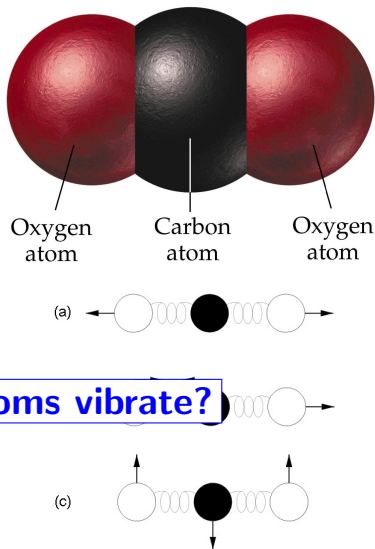


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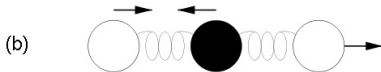
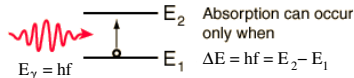
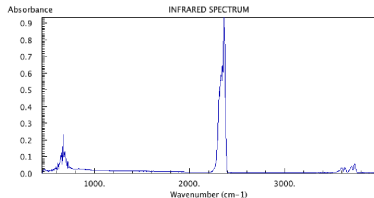


CO₂ Absorption Spectrum

The CO₂ absorption spectrum shown below has a prominent absorption peak at $k = 2350\text{ cm}^{-1}$.

The peak is located at the frequency of light that is absorbed as the CO₂ molecule makes the transition from one quantized energy state to a higher one. The energy of the light is $E_\gamma = hf$ where h is Planck's constant.

The atoms vibrate in the asymmetric mode shown [here](#). This particular mode gives CO₂ its greenhouse gas properties.



The Harmonic Oscillator

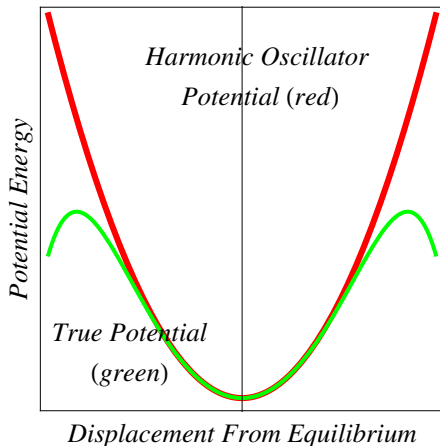
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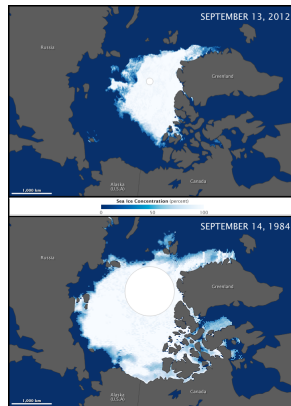
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- 1 The Force: $F_s = -kx$ where x is the displacement from equilibrium.
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The Arctic is Melting

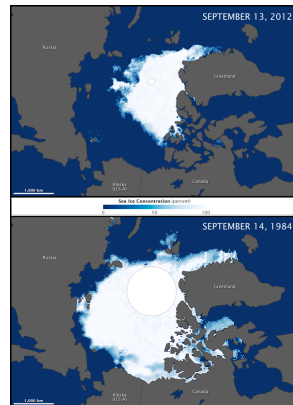
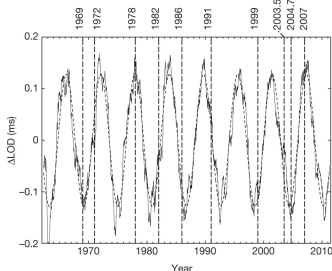
- 1 Arctic sea has shown a large drop in area over the last thirty years.
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Japanese and US satellite data

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- 4 Can we detect the effect of these changes in the length of the day?



Japanese and US satellite data

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