Phys 301 Class 28
Other Potential Wells

Finish Part V of Class 26 Handout

- If you finished, be the teacher for those around you who did not.

Review: Conditions for $\psi(x)$

- In order for $|\psi(x)|^2$ to be physically meaningful…
  - $\psi(x)$ must be continuous.
  - $\psi(x) = 0$ where it's impossible for the particle to be.
  - $\psi(x) \to 0$ as $x \to -\infty$ and $x \to +\infty$
  - $\psi(x)$ must be properly normalized such that:

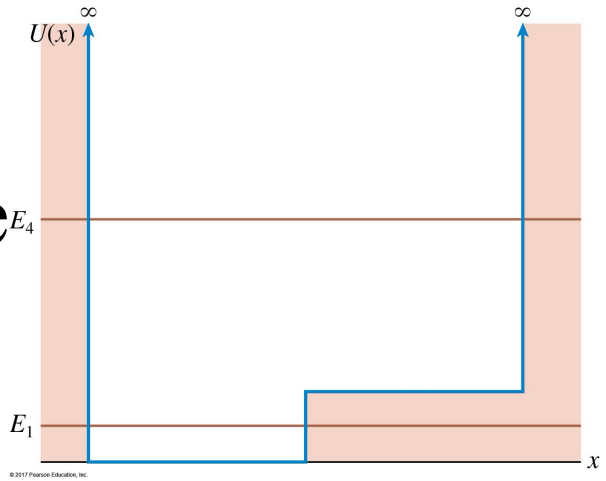
$$\int_{-\infty}^{+\infty} |\psi(x)|^2 dx = 1$$

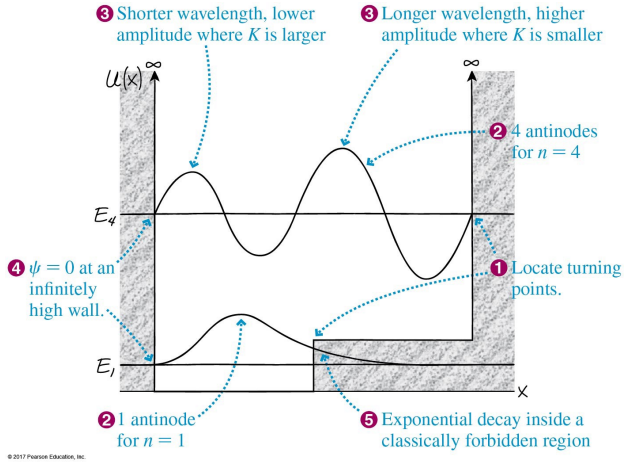
Review: Additional Rules for $\psi(x)$

- Where $E > U$, sinusoidal (complex exponential)
  - n antinodes for n^{th} bound state.
  - Higher k (shorter wavelength) where kinetic energy K is larger ($|E - U|$ greater)
  - Amplitude is smaller where $|E - U|$ greater (spends less time there – less likely to be found).
- Where $E < U$, (real) exponential
  - Smaller $|E - U|$, greater penetration distance.

Applications of Rules

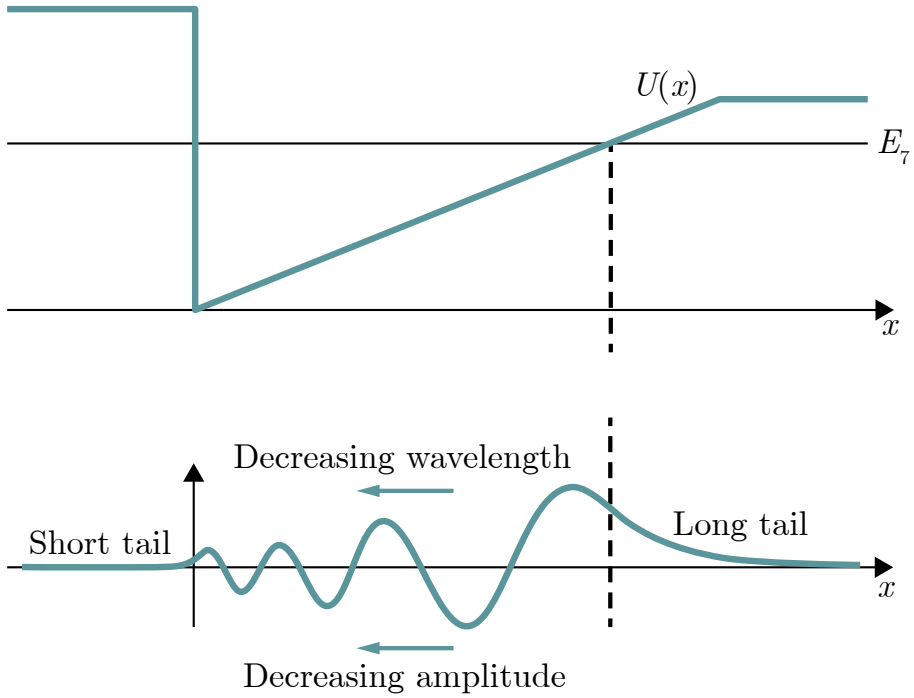
- Can apply to any arbitrary potential function and create a rough sketch of the wave function.
- Example 1: step-function



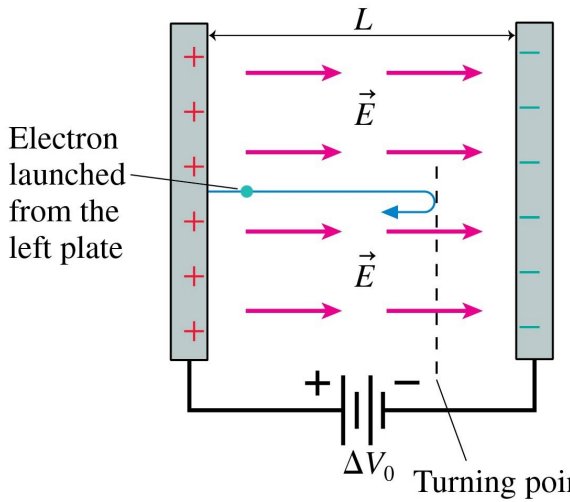


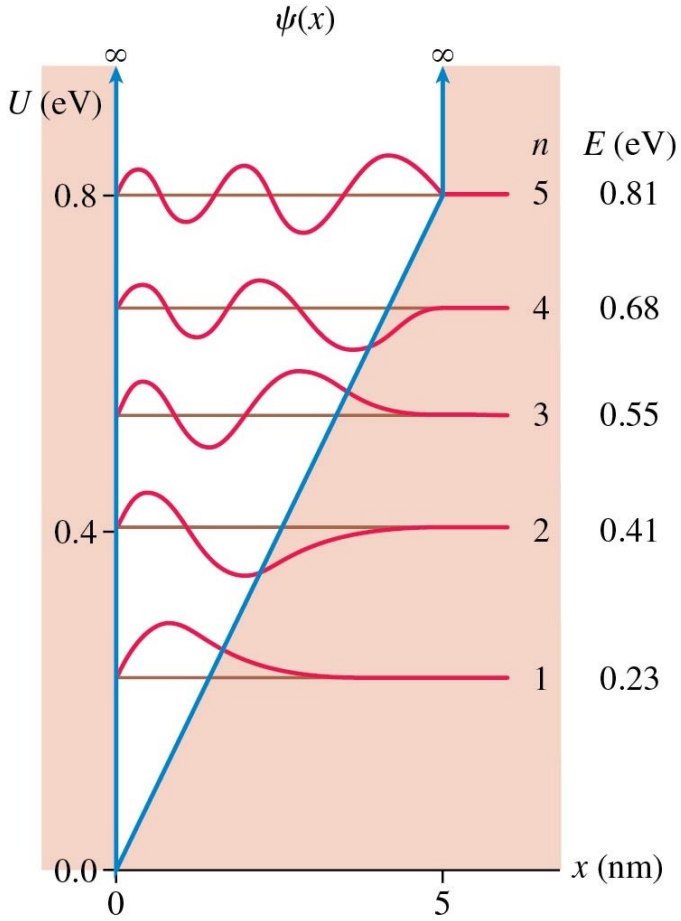
Let's Try One

- Sketch the energy eigenfunction corresponding to the 7^{th}–lowest possible energy for a particle whose potential energy as a function of x is shown to the right.



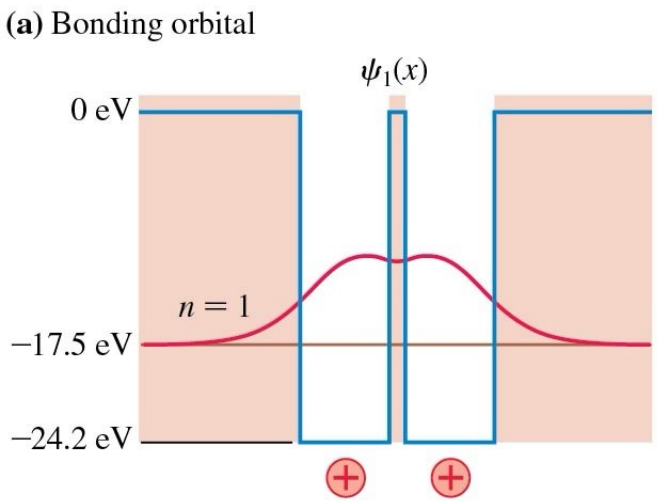
Example 2: "Sloped" potential, electron in the space inside a capacitor

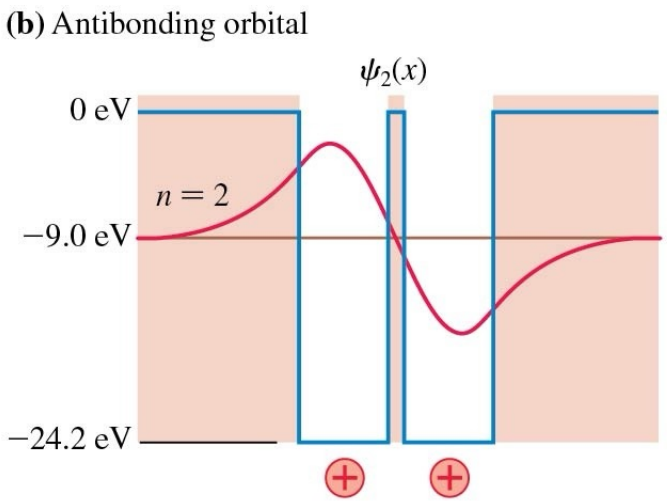


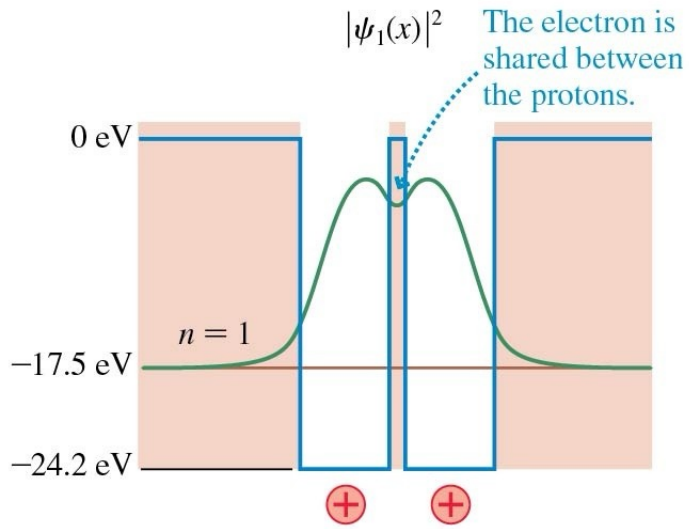


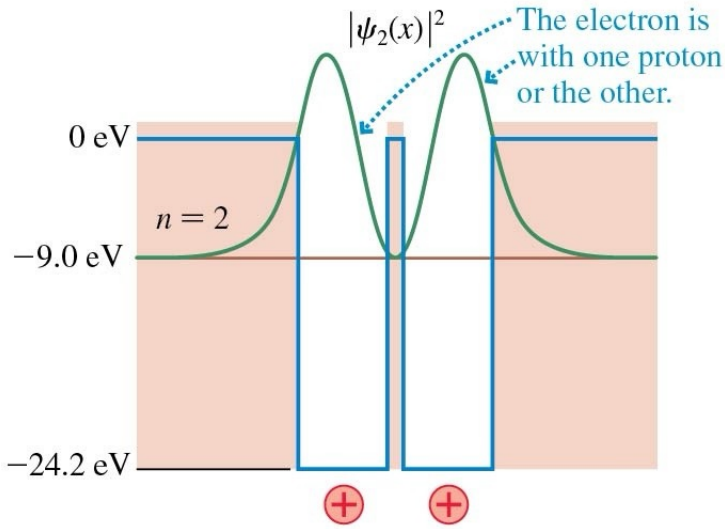
- For each wavefunction: k decreases (wavelength increases) and amplitude increases gradually to the right.

Example 3: Covalent Bond (Electron "shared" by two atoms)

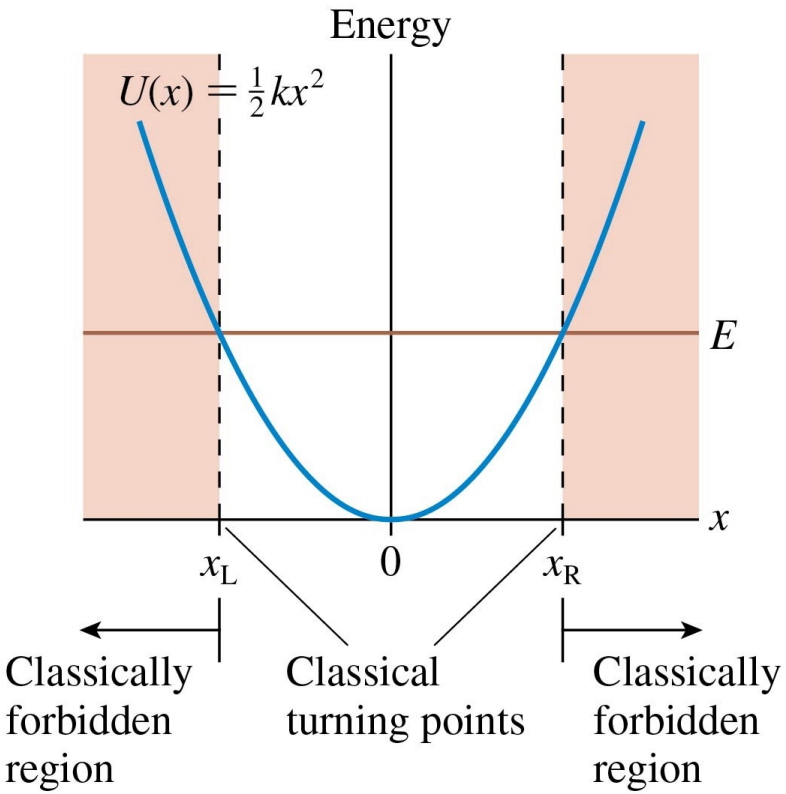








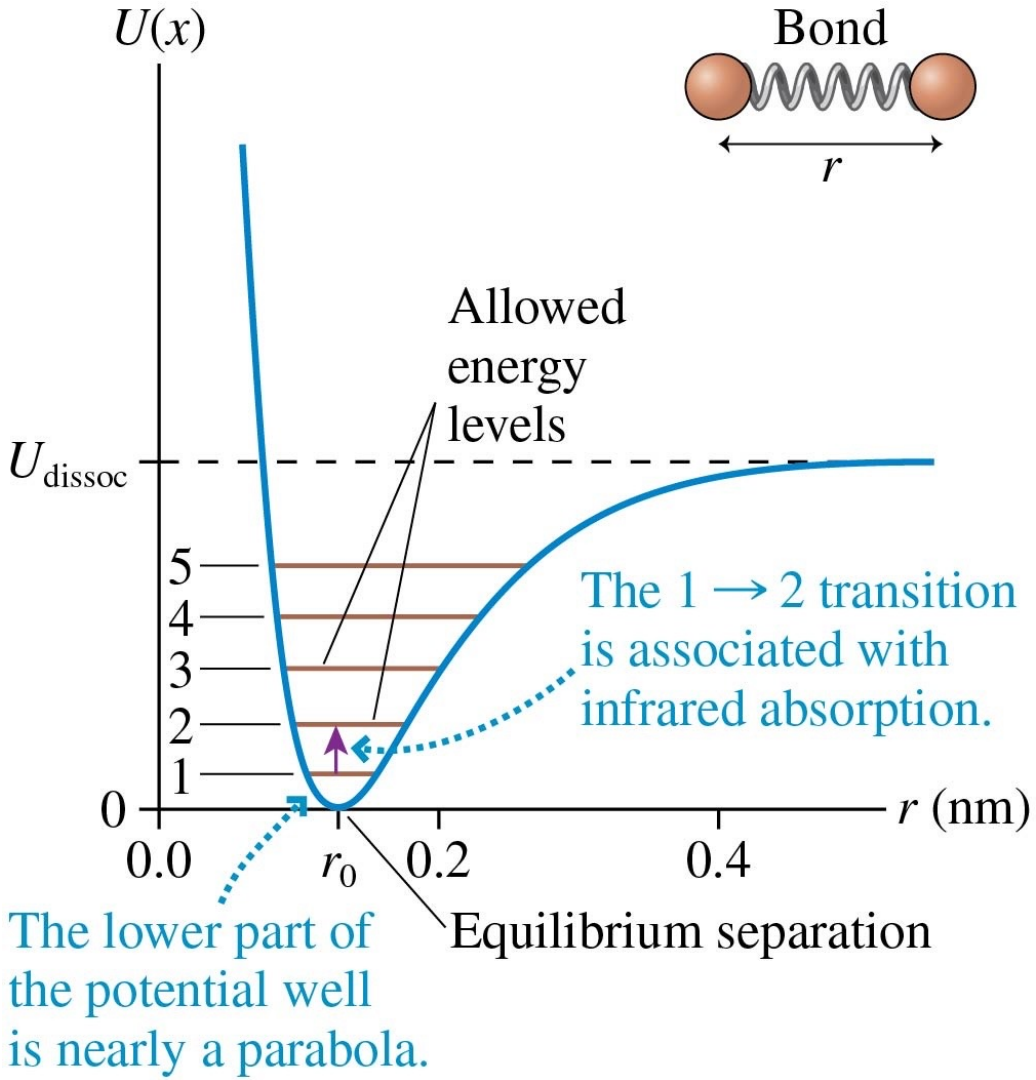
Quantum Mechanical Oscillator



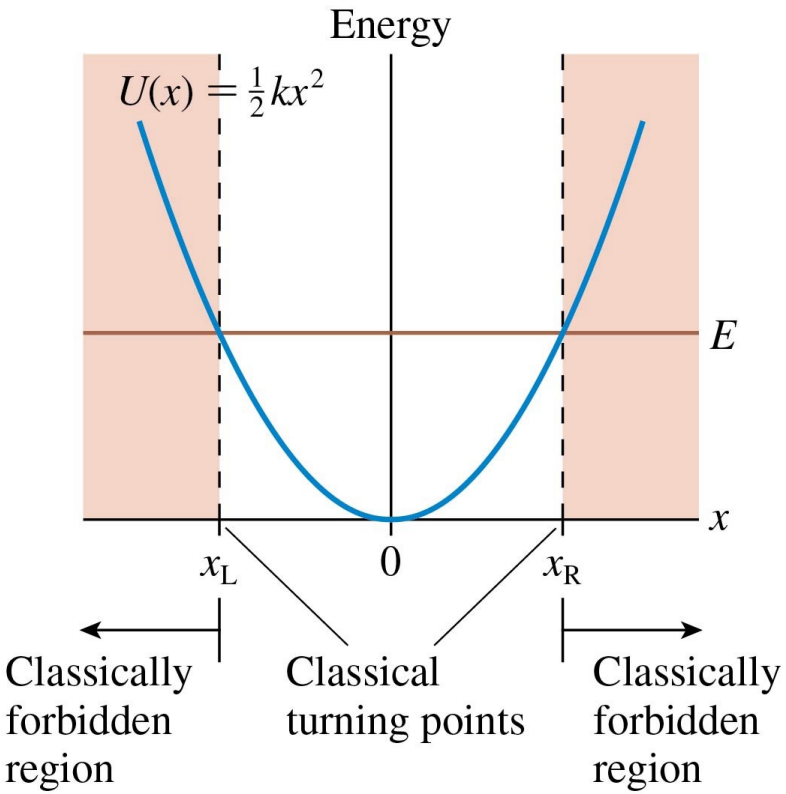
- Useful model for…

Molecular Vibrations

- Figured out potential in previous class.
- Rotational modes in between vibrational energy levels!
- Predict: what wavelengths?



Quantum Mechanical Oscillator



- Handout, with focus on comparing to classical system (*e.g.*, mass on a spring).