Quantum Mechanics (Griffiths): Problem 2.2

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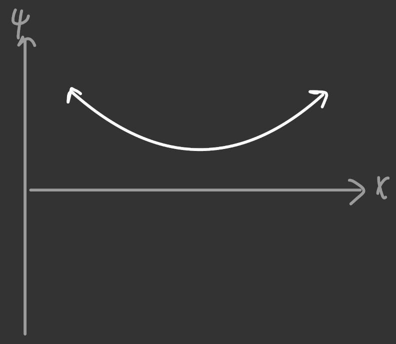
Part A

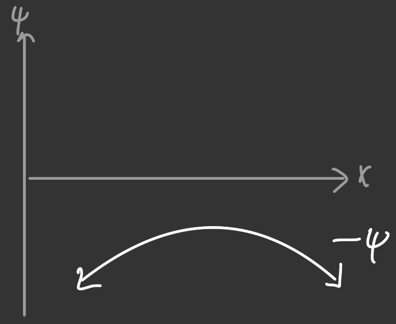
We were hinted to write the time-independent Schrodinger equation as

$$\frac{d^2\psi}{dx^2} = \frac{2m}{\hbar^2}\left[V\left(x\right) - E\right]\psi, \tag{1}$$

which expresses the curvature of the wave function as the difference between potential and energy. First, if we assume that $V > E$, then equation 1 is *positive*, leading to a positive curvature of the wave function as shown below.

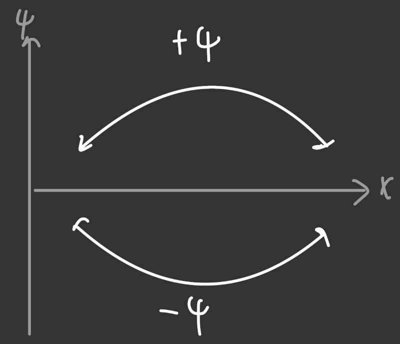


However, assuming we had a negative wave function $-\psi$, then the curvature would be negative, leading to the wave function below.



Both are technically wave functions, but they are not normalizable, because as you progress further any x direction, the wave function blows up.

Now consider the case $V < E$, under the same logic above, our wave functions for both $\pm\psi$ look like this.



Now we have normalizable wave functions! Thus, you must have some energy E that is greater than the potential for normalizable solutions.