

Computer Assignment 2

In this problem, you have to obtain the evolution of the wavefunction by deriving the time-evolution operator. Divide the position axis into 100 divisions as in Assignment 1, write the Hamiltonian operator in matrix form, and use it to obtain the time evolution operator.

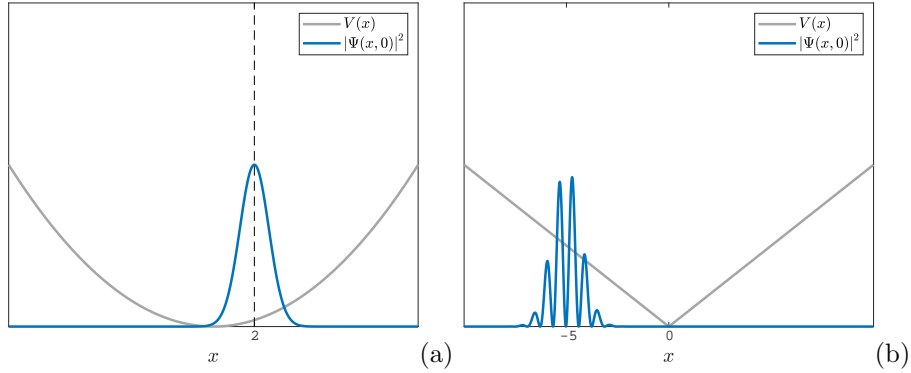


Figure 1: (a)Q1 (b)Q2

Q1

A particle in the gaussian wave-packet state

$$\Psi(x, 0) = \frac{1}{\sqrt{\sigma\sqrt{2\pi}}} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right) \quad (1)$$

experiences the harmonic potential

$$V(x) = \frac{1}{2} kx^2 \quad (2)$$

Numerically find the state of the particle at a future time t .
Take $\sigma = \hbar = m = k = 1$, $\mu = 2$

Q2

A particle is in the following state

$$\Psi(x, 0) = \sin(10\pi x) \frac{1}{\sqrt{\sigma\sqrt{2\pi}}} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right) \quad (3)$$

experiences the harmonic potential

$$V(x) = |x| \quad (4)$$

Numerically find the state of the particle at a future time t .
Take $\sigma = \hbar = m = k = 1$, $\mu = -5$

Submit ONE pdf file containing your algorithm, and TWO animation files showing the time-evolution of $|\Psi|^2$.