Problem Set 4 Latex Report

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1 Problem 1

The error calculated was 0.605303030 percent, while the actual error was 0.00605909090 percent. Our error calculated was slightly smaller than our actual error. This might be due to the computer's error while adding.

2 Problem 2

2.1 Part a)

given $E = V(a)$,

$$V(a) = \frac{1}{2} * m * (\frac{dx}{dt})^2 + V(x)$$

so

$$m * \frac{dx}{dt} = \sqrt{2 * (V(a) - V(x))}$$

now integrating;

$$\int_0^a \frac{m}{\sqrt{2 * (V(a) - V(x))}} \, dx = \int_0^{\frac{T}{4}} \, dt$$

we get;

$$T = \sqrt{8m} \int_0^a \frac{1}{\sqrt{(V(a) - V(x))}} \, dx$$

2.2 Part b)

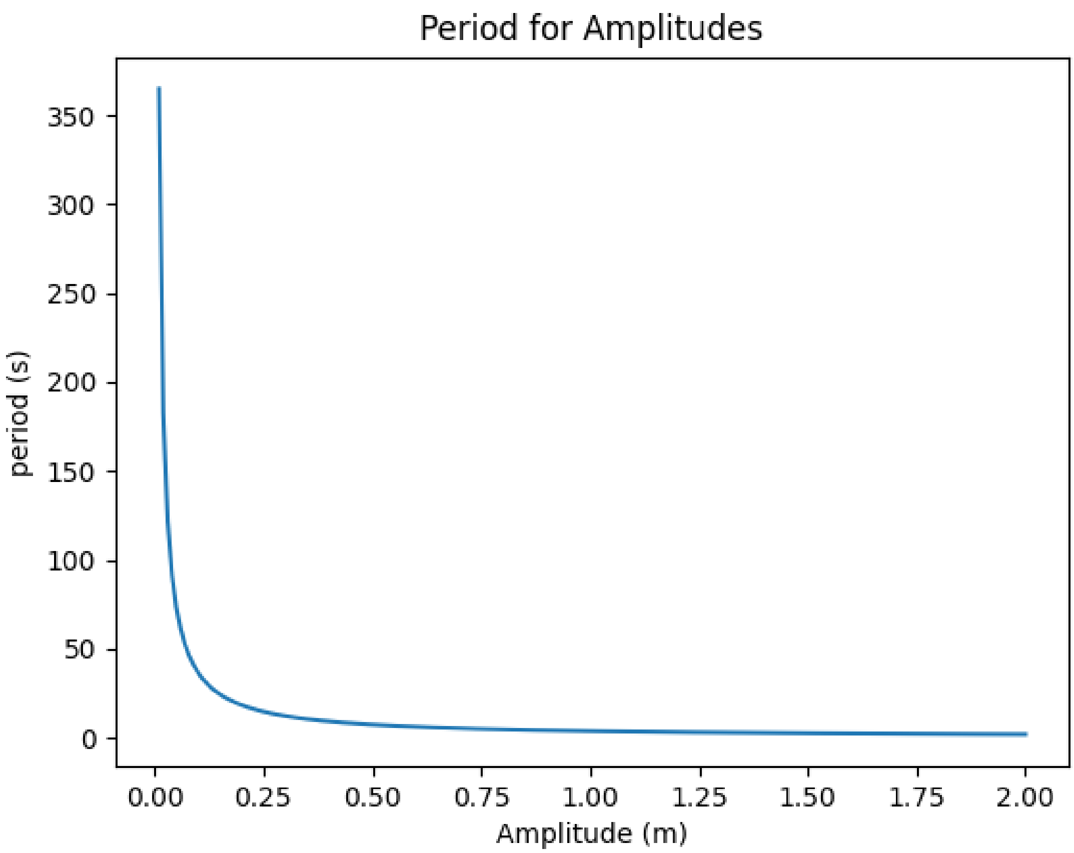

Figure 1: Harmonic oscillator period

2.3 Part c)

As seen in Figure 1, the period diverges as the amplitude goes to 0. This can be explained since the period depends on $\frac{1}{\sqrt{(V(a)-V(x))}}$ where $V(a) - V(x)$ is getting smaller as a approaches 0.

3 Problem 3

3.1 Part a)

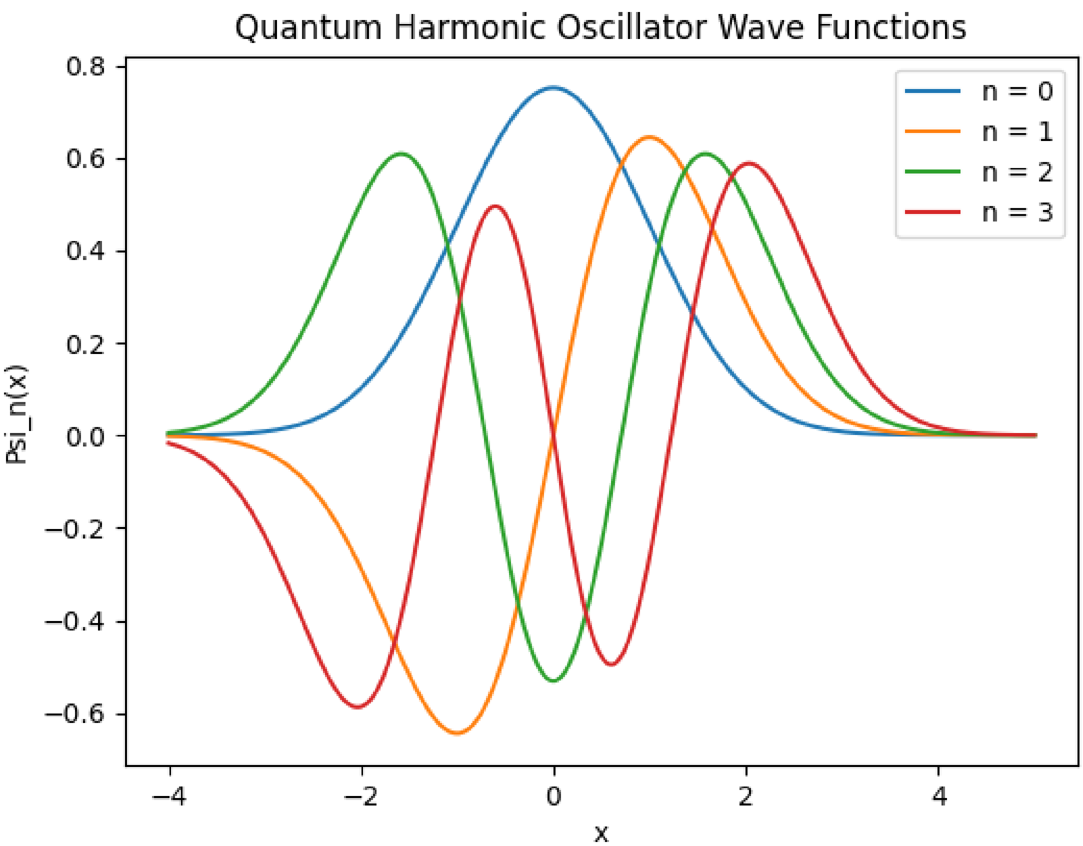

Figure 2: Quantum oscillator with n =0,1,2,3

3.2 Part b)

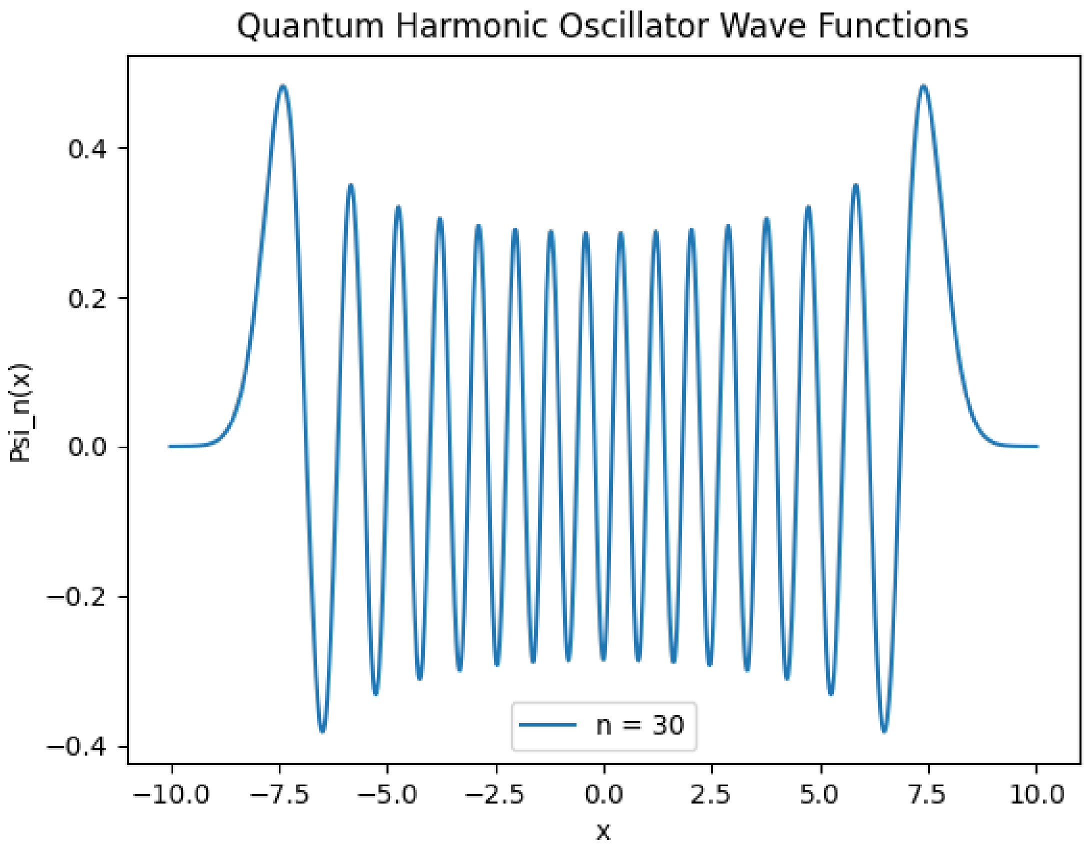

Figure 3: Quantum oscillator with n =30

3.3 Part c)

Using Gaussian quadrature and modifying the bounds, we can integrate the integral:

$$\int_{-\infty}^{\infty} x^2 |\psi_n(x)|^2 \, dx$$

The result comes out to be: 2.345207874

3.4 Part d)

The result of performing the same integral in part c with the Gauss-Hermite quadrature is 2.34520788. This is an exact result since our integrated function was based on Hermite polynomials.