Computational Physics Problem Set 4

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GitHub: https://github.com/jferrante25/physga-2000

1 Problem 1 (Newman 5.9)

Part A: in GitHub file
Part B: See Figure 1
Part C: See Figure 2

2 Problem 2 (Newman 5.10)

Part A:
Starting with:
$E = V(a) = \frac{1}{2}m(\frac{dx}{dt})^2 + V(x)$
$V(a) - V(x) = \frac{1}{2}m(\frac{dx}{dt})^2$
$\sqrt{(V(a) - V(x))} = \sqrt{\frac{m}{2}}\frac{dx}{dt}$
$dt = \sqrt{\frac{m}{2}}\frac{dx}{\sqrt{V(a)-V(x))}}$
$\int_0^{\frac{1}{4}T} dt \ = \sqrt{\frac{m}{2}}\int_0^a \frac{dx}{\sqrt{(V(a)-V(x))}}$
T=$\sqrt{8m}\int_0^a \frac{dx}{\sqrt{(V(a)-V(x))}}$

Part B: Code in GitHub file. See Figure 3

Part C: These results can be explained by the fact that the potential is of a higher power than the kinetic energy, so that small amplitudes yield very small accelerations and large amplitudes very fast ones.

3 Problem 3 (Newman 5.13)

Part A: Code in GitHub file. See Figure 4

Part B: See Figure 5.

Part C: Code in GitHub file. Value obtained for $\sqrt{< x^2 >}$: 2.3452078737858177

Part D: Code in GitHub file. Value obtained for: $\sqrt{< x^2 >}$: 1.3134828745930671 Exact evaluation of the integral cannot be made.

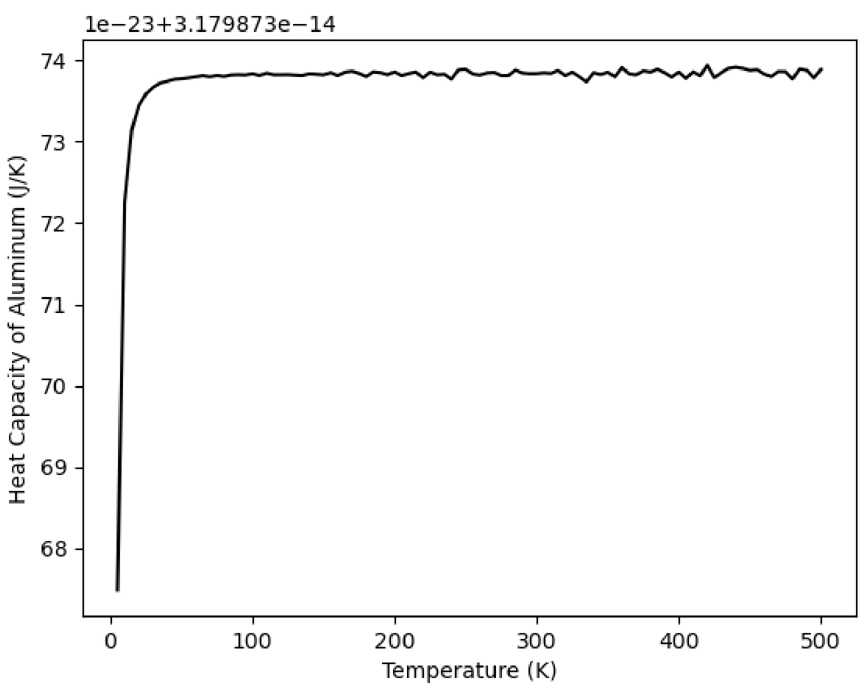

Figure 1: Plot of heat capacity of 1000 cubic centimeter aluminum sample evaluated using Gaussian quadrature

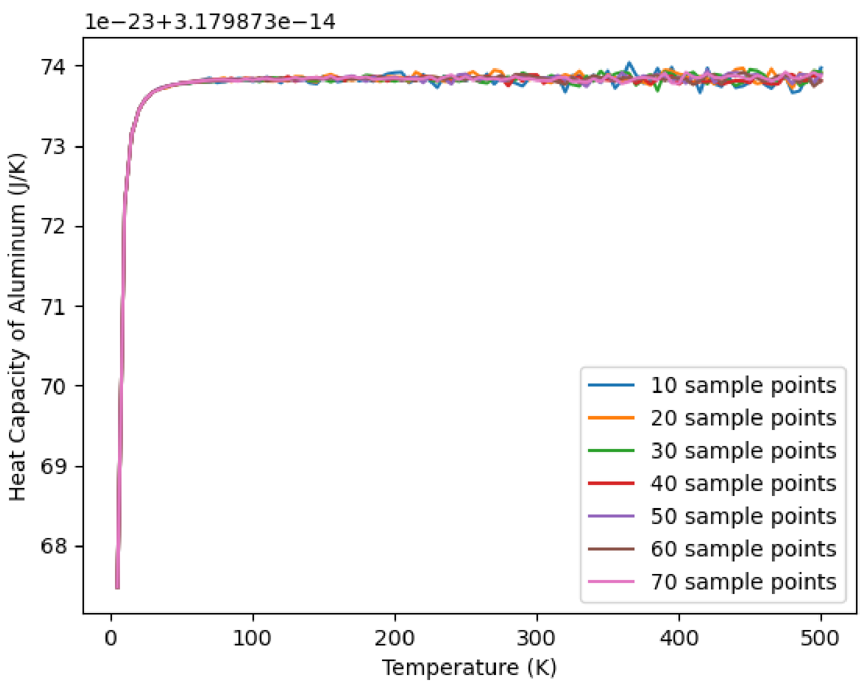

Figure 2: Plot of heat capacity of 1000 cubic centimeter aluminum sample, evaluated using Gaussian quadrature for number of sample points N=10,20,30,40,50,60,70

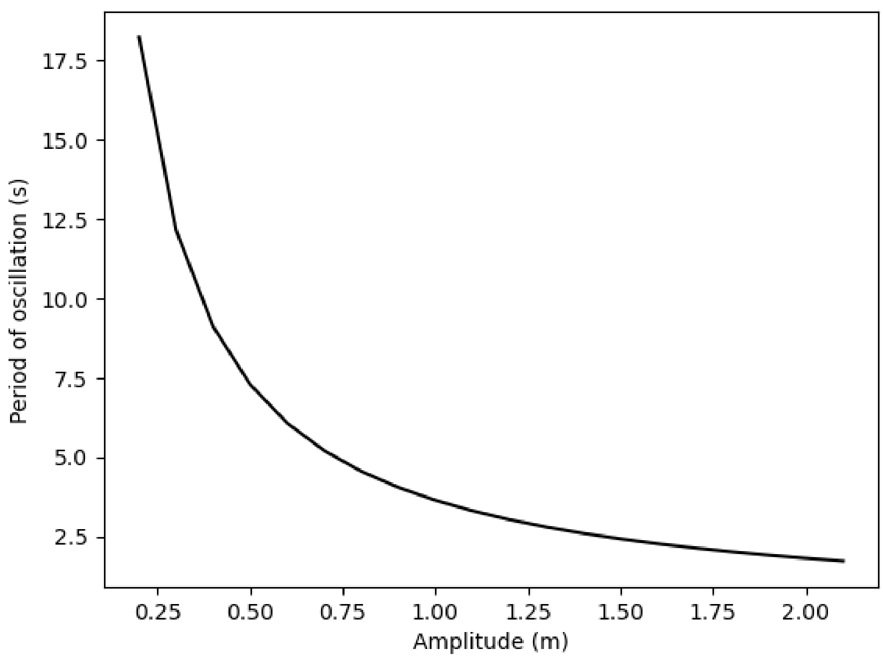

Figure 3: Plot of period of anharmonic oscillator vs. amplitude

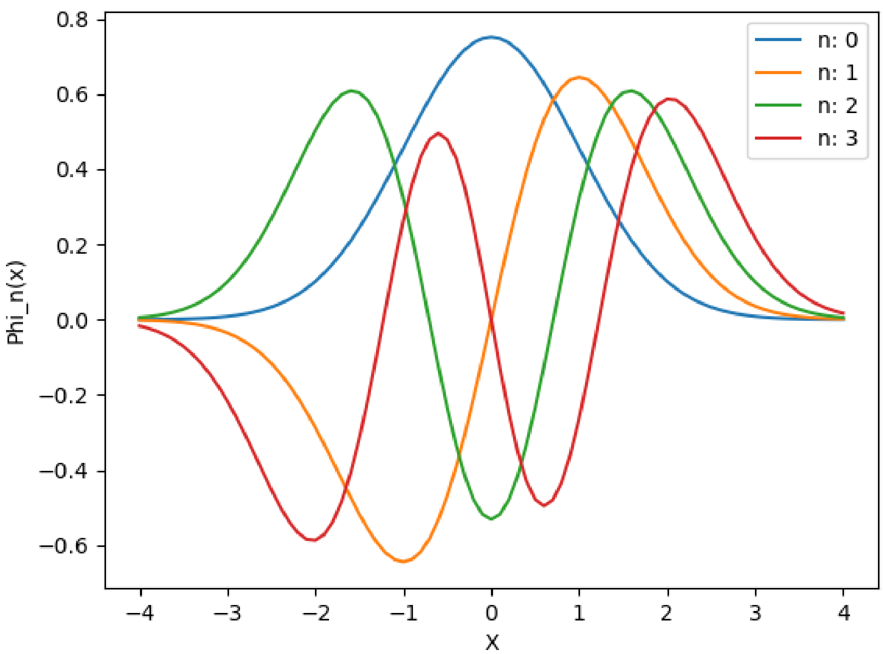

Figure 4: Plot of quantum harmonic oscillator wave function for n=0,1,2,3

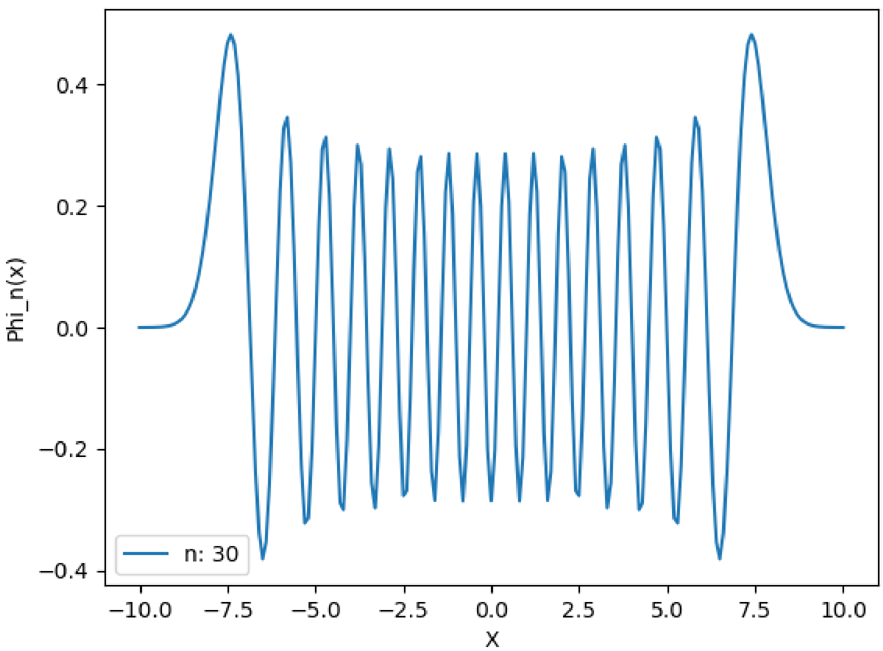

Figure 5: Plot of quantum harmonic oscillator wave function for n=30