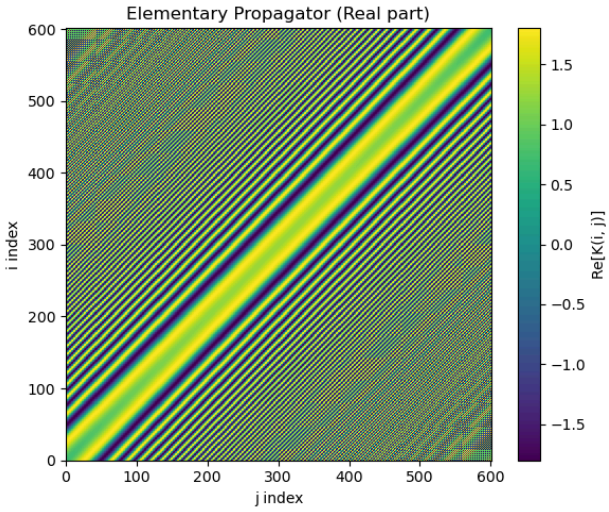
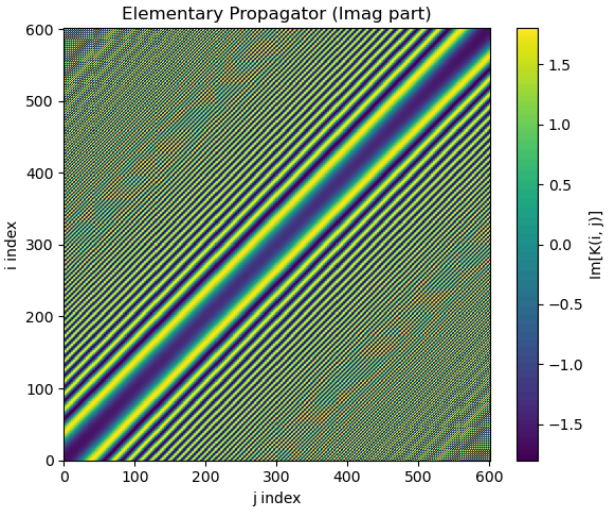
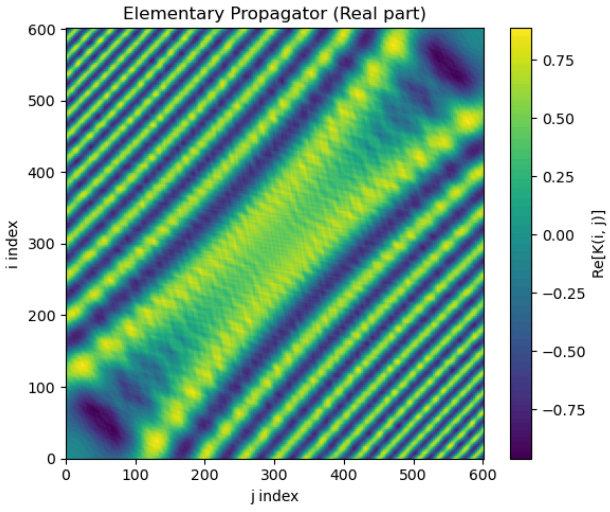
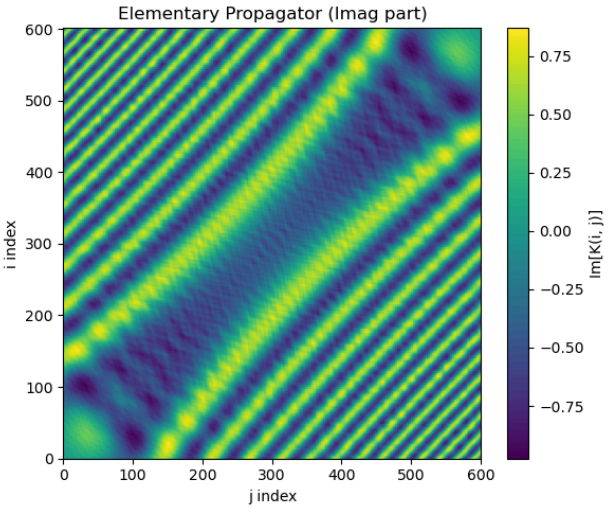
PROBLEM A


Elementary Propagator (Real part)
i index
j index
Re[K(i, j)]


Elementary Propagator (Imag part)
i index
j index
Im[K(i, j)]


Elementary Propagator (Real part)
i index
j index
Re[K(i, j)]

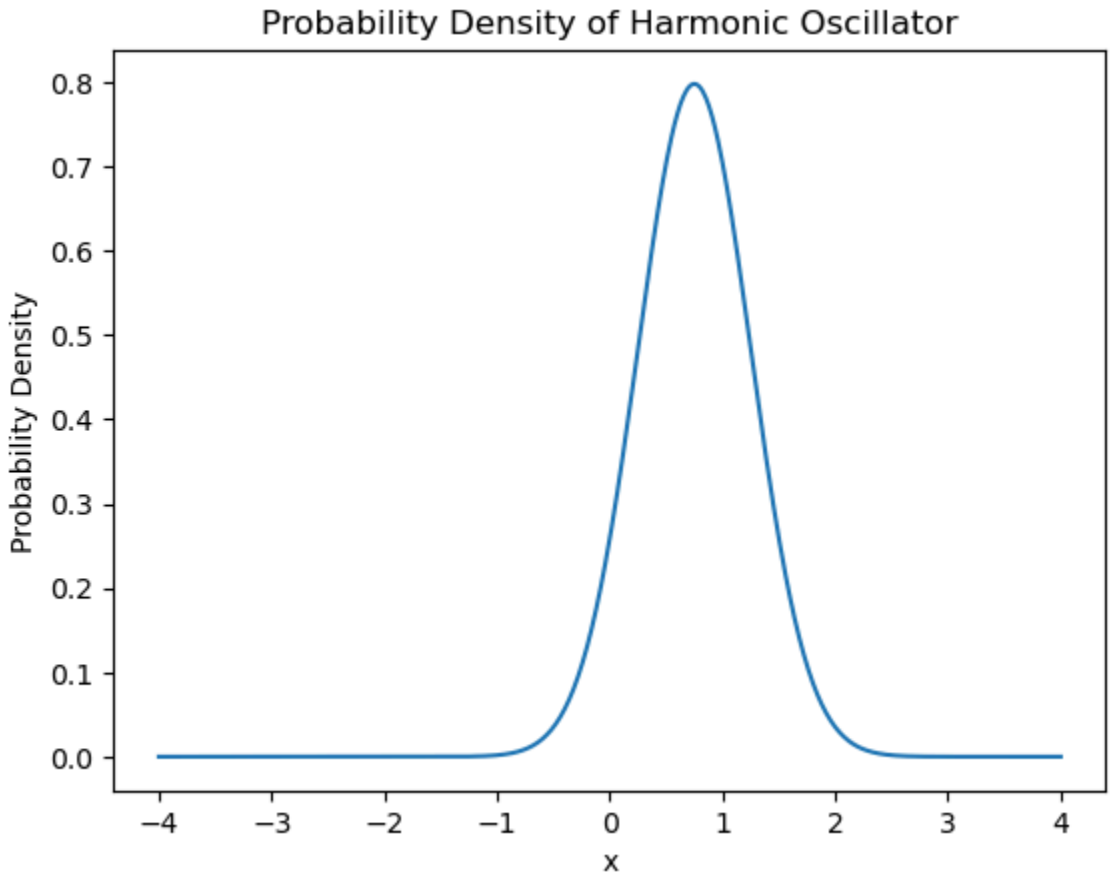

Elementary Propagator (Imag part)
i index
j index
Im[K(i, j)]

```
print(k_8eps)
```

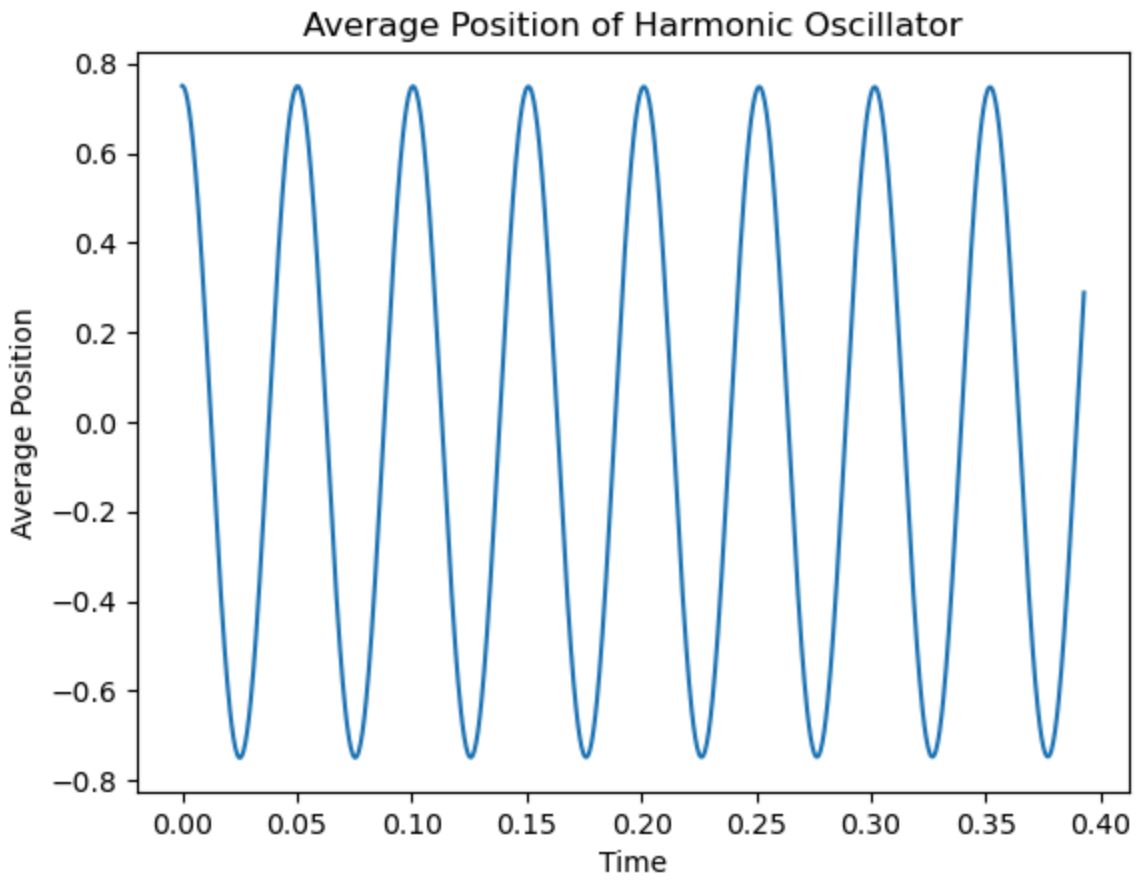
[24] ✓ 0.0s Open 'k_8eps' in Data Wrangler

```
[[-0.05955857+0.01786716j -0.07576122+0.02170276j -0.07967379+0.05414069j
  ... -0.46505934-0.30932662j -0.35439298-0.42735606j
  -0.2168743 -0.50917196j]
 [-0.07576125+0.02170283j -0.0896081 +0.03330258j -0.08308481+0.06724797j
  ... -0.5340409 -0.16837671j -0.4614194 -0.31131655j
  -0.3543931 -0.42735562j]
 [-0.07967392+0.05414072j -0.08308499+0.06724811j -0.06226969+0.0930306j
  ... -0.5640737 -0.01040979j -0.53404117-0.16837703j
  -0.46506009-0.3093264j ]
 ...
 [-0.46505934-0.3093265j  -0.5340409 -0.1683766j  -0.5640738 -0.01040973j
  ... -0.06227011+0.09303051j -0.08308521+0.06724772j
  -0.0796742 +0.05414026j]
 [-0.3543929 -0.42735612j -0.46141946-0.3113167j  -0.53404105-0.16837695j
  ... -0.08308517+0.06724776j -0.08960827+0.03330211j
  -0.0757613 +0.02170216j]
 [-0.2168743 -0.5091721j  -0.3543931 -0.42735577j -0.4650602 -0.30932644j
  ... -0.07967409+0.05414031j -0.07576124+0.02170226j
  -0.05955863+0.01786645j]]
```

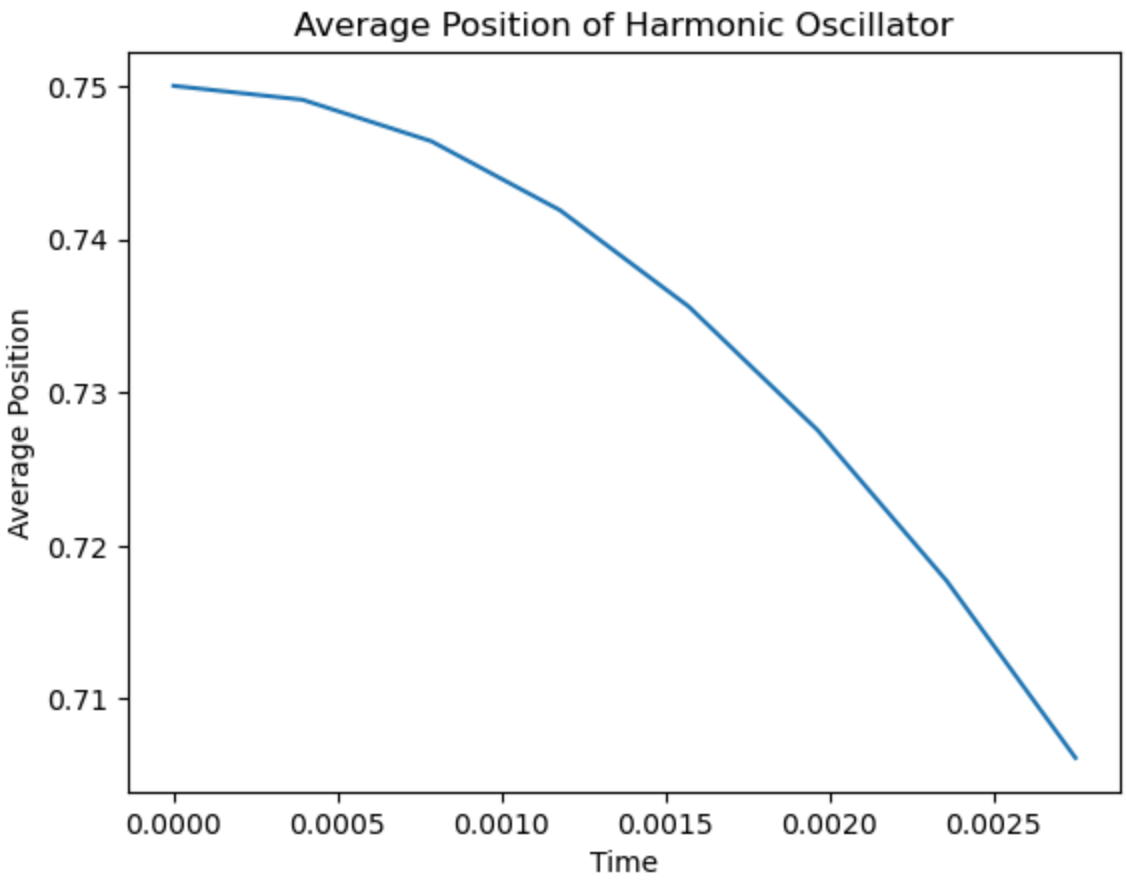
Problem B



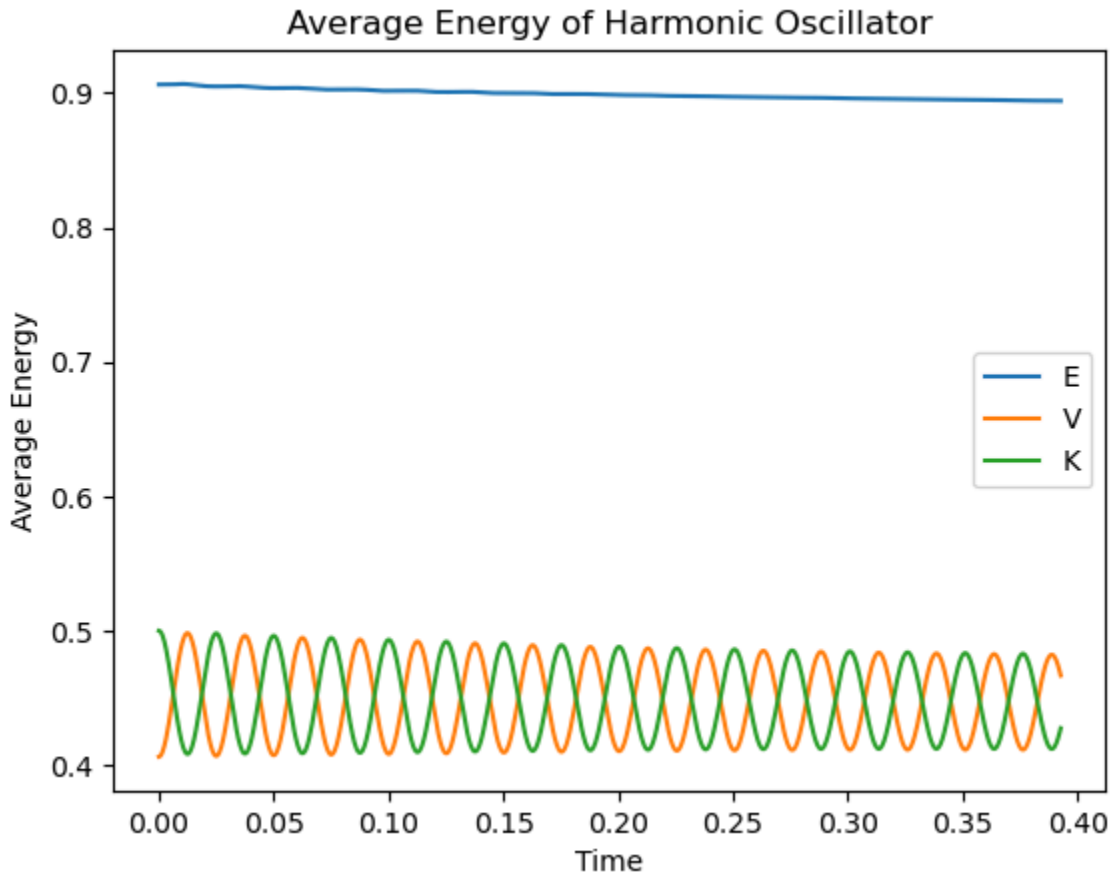
This is the probability density function plotted with respect to X. This was done to verify results and make sure the answer makes sense somewhat.



The problem asks to plot 8 timesteps but it's difficult to verify what the function is so I plotted 1000 to make sure I get periodic behaviour.

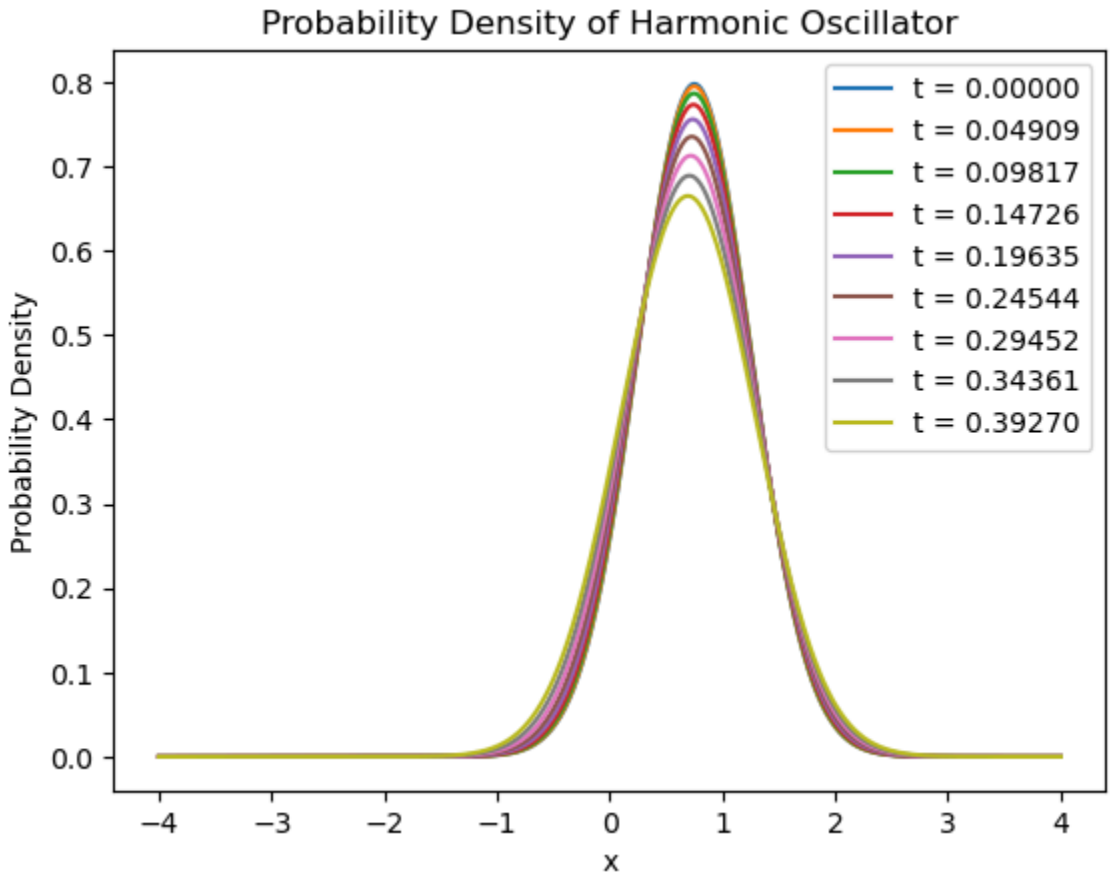

Average Position of Harmonic Oscillator
0.75
0.74
0.73
0.72
0.71
Average Position
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Time

Problem C

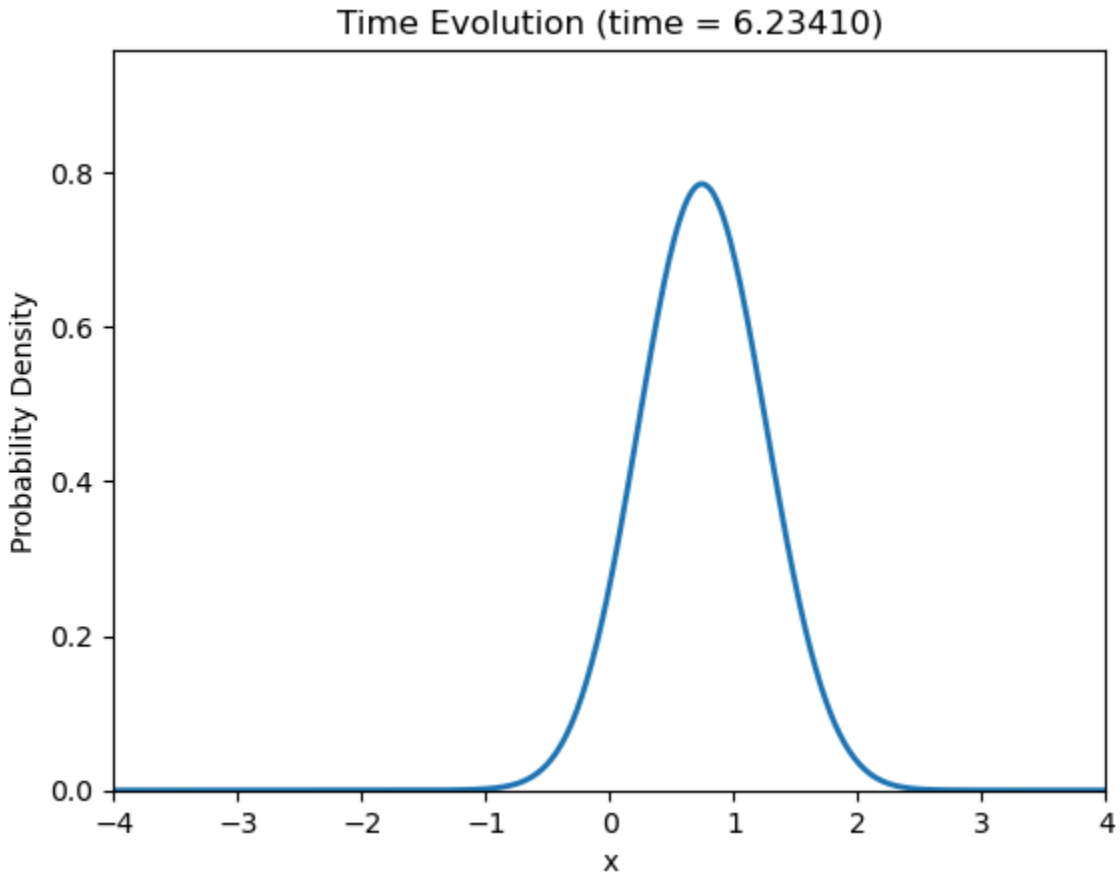


I once again plotted 1000 timesteps because I wanted to verify the results. The line for E is drifting due to numerical precision but should be a straight line.

Problem D


Probability Density of Harmonic Oscillator
Probability Density
x
t = 0.00000
t = 0.04909
t = 0.09817
t = 0.14726
t = 0.19635
t = 0.24544
t = 0.29452
t = 0.34361
t = 0.39270
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
−4
−3
−2
−1
0
1
2
3
4

Problem E



The GIF is bundled with the code in the zip file.