4. Analysis

I. Table with the values of total energy at the final time for both the Euler and leapfrog methods, for different values of dt.

dt	E_{total}, Euler	E_{total}, Leapfrog
0.5	-0.003494719970418	-0.004535197177447
0.05	-0.004400277339728	-0.004535079857163
0.005	-0.004520330108893	-0.004535068426158
0.0005	-0.0045	-0.0045

II. Responses

1. How does changing dt affect the simulation when using Euler method, and when using Leapfrog method?

   We can see from the table that the total energy is changed by different t value and different method. For Euler method, when dt becomes larger, the value of total energy will change a lot. We can see that when dt=0.0005, E_{total} = -0.0045. And when dt=0.5, E_{total}= -0.003494719970418.

   For Leapfrog method, when dt becomes larger, the value of total energy has a nearly negligible change. We can see that when dt = 0.0005, E_{total} = -0.0045. And when dt = 0.5, E_{total} is also very close to -0.0045.

2. What does this suggest to you about the forward Euler method?

   We can conclude that Leapfrog method is more accurate than Euler method. Since if the step is larger, the Euler will have a large error. Therefore, if we want to use Euler method, we need to choose a very small time step to make the result more accurate.