1) The total kinetic energy of a collection of Nparticles grows linearly with N assuming each particle has the same kinetic energy (Figure 1). When particle number increase, the kinetic energy also increases.

The total kinetic energy values were computed for five different the particle values (15, 30, 45, 60, 75) by assuming each particle has the same average kinetic energy. In the calculations, it was assumed that each particle has the same mass (1.0 in natural units of mass) and the same velocity (3.5 in natural units of velocity). The outcomes of each run were shown below.

Table 1: Relationship between kinetic energy and particle number

|  |  |
| --- | --- |
| Particle Number | Kinetic Energy |
| 15 | 91.8 |
| 30 | 183.7 |
| 45 | 275.6 |
| 60 | 367.5 |
| 75 | 459.3 |

In [**12**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation-Kinetic Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**15**

Result from loop is **91.875**

Result from numpy sum is **91.875**

Kinetic energy is for each particule [6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125]

In [**13**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation-Kinetic Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**30**

Result from loop is **183.75**

Result from numpy sum is **183.75**

Kinetic energy is for each particule [6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125]

In [**14**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation-Kinetic Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**45**

Result from loop is **275.625**

Result from numpy sum is **275.625**

Kinetic energy is for each particule [6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125]

In [**15**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation-Kinetic Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**60**

Result from loop is **367.5**

Result from numpy sum is **367.5**

Kinetic energy is for each particule [6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125]

In [**16**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation-Kinetic Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**75**

Result from loop is **459.375**

Result from numpy sum is **459.375**

Kinetic energy is for each particule [6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125 6.125

6.125 6.125 6.125]

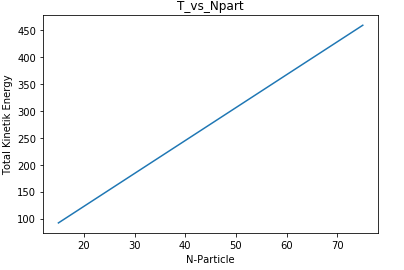


Figure 1. Relationship between kinetic energy and particle number

2) The total potential energy of a collection of a Nparticles grows quadratically with N assuming each particle spaced equally (Figure 2). The total potential energy were computed for five different particle values (15, 30, 45, 60, 75). In the calculations, it was assumed that each particle a charge of 1 natural unit and space evenly along the x-axis with interparticle separation of 0.2 units of length. It is also assumed 1/ (4\* (22/7) \* Eo) =1 in natural unit system. The outcomes of each run were shown below.

Table 2: Relationship between potential energy and particle number

|  |  |
| --- | --- |
| Particle Number | Potential Energy |
| 15 | 347.7 |
| 30 | 898.5 |
| 45 | 1527.7 |
| 60 | 2207.9 |
| 75 | 2926.0 |

In [**5**]:

runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation to Phyton-Potential Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**15**

Printing array of charges [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]

Printing array of position [0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8]

Printing array of separation of particles

[[0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8]

[0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6]

[0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4]

[0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2]

[0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. ]

[1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8]

[1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6]

[1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4]

[1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2]

[1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. ]

[2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8]

[2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6]

[2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4]

[2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2]

[2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. ]]

**347.7343489843489**

In [**6**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation to Phyton-Potential Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**30**

Printing array of charges [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1.]

Printing array of position [0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4

3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4 5.6 5.8]

Printing array of separation of particles

[[0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4

3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4 5.6 5.8]

[0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2

3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4 5.6]

[0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3.

3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4]

[0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8

3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2]

[0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6

2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. ]

[1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4

2.6 2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8]

[1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2

2.4 2.6 2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6]

[1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2.

2.2 2.4 2.6 2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4]

[1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8

2. 2.2 2.4 2.6 2.8 3. 3.2 3.4 3.6 3.8 4. 4.2]

[1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6

1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4 3.6 3.8 4. ]

[2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4

1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4 3.6 3.8]

[2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2

1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4 3.6]

[2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1.

1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4]

[2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8

1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2]

[2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6

0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. ]

[3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4

0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8]

[3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2

0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6]

[3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0.

0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4]

[3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2

0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2]

[3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4

0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. ]

[4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6

0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8]

[4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1. 0.8

0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6]

[4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2 1.

0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4]

[4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4 1.2

1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. 1.2]

[4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6 1.4

1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8 1. ]

[5. 4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8 1.6

1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6 0.8]

[5.2 5. 4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2. 1.8

1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4 0.6]

[5.4 5.2 5. 4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2 2.

1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2 0.4]

[5.6 5.4 5.2 5. 4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4 2.2

2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. 0.2]

[5.8 5.6 5.4 5.2 5. 4.8 4.6 4.4 4.2 4. 3.8 3.6 3.4 3.2 3. 2.8 2.6 2.4

2.2 2. 1.8 1.6 1.4 1.2 1. 0.8 0.6 0.4 0.2 0. ]]

**898.4961392761172**

In [**7**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation to Phyton-Potential Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**45**

Printing array of charges [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]

Printing array of position [0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6 2.8 3. 3.2 3.4

3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4 5.6 5.8 6. 6.2 6.4 6.6 6.8 7.

7.2 7.4 7.6 7.8 8. 8.2 8.4 8.6 8.8]

Printing array of separation of particles

[[0. 0.2 0.4 ... 8.4 8.6 8.8]

[0.2 0. 0.2 ... 8.2 8.4 8.6]

[0.4 0.2 0. ... 8. 8.2 8.4]

...

[8.4 8.2 8. ... 0. 0.2 0.4]

[8.6 8.4 8.2 ... 0.2 0. 0.2]

[8.8 8.6 8.4 ... 0.4 0.2 0. ]]

1527.7266519981042

In [**8**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation to Phyton-Potential Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

60

Printing array of charges [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]

Printing array of position [ 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6

2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4

5.6 5.8 6. 6.2 6.4 6.6 6.8 7. 7.2 7.4 7.6 7.8 8. 8.2

8.4 8.6 8.8 9. 9.2 9.4 9.6 9.8 10. 10.2 10.4 10.6 10.8 11.

11.2 11.4 11.6 11.8]

Printing array of separation of particles

[[ 0. 0.2 0.4 ... 11.4 11.6 11.8]

[ 0.2 0. 0.2 ... 11.2 11.4 11.6]

[ 0.4 0.2 0. ... 11. 11.2 11.4]

...

[11.4 11.2 11. ... 0. 0.2 0.4]

[11.6 11.4 11.2 ... 0.2 0. 0.2]

[11.8 11.6 11.4 ... 0.4 0.2 0. ]]

**2207.9222477710564**

In [**9**]: runfile('/Users/melissasuchanek/Desktop/Figen Files/Orientation to Phyton-Potential Energy.py', wdir='/Users/melissasuchanek/Desktop/Figen Files')

**75**

Printing array of charges [1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.

1. 1. 1.]

Printing array of position [ 0. 0.2 0.4 0.6 0.8 1. 1.2 1.4 1.6 1.8 2. 2.2 2.4 2.6

2.8 3. 3.2 3.4 3.6 3.8 4. 4.2 4.4 4.6 4.8 5. 5.2 5.4

5.6 5.8 6. 6.2 6.4 6.6 6.8 7. 7.2 7.4 7.6 7.8 8. 8.2

8.4 8.6 8.8 9. 9.2 9.4 9.6 9.8 10. 10.2 10.4 10.6 10.8 11.

11.2 11.4 11.6 11.8 12. 12.2 12.4 12.6 12.8 13. 13.2 13.4 13.6 13.8

14. 14.2 14.4 14.6 14.8]

Printing array of separation of particles

[[ 0. 0.2 0.4 ... 14.4 14.6 14.8]

[ 0.2 0. 0.2 ... 14.2 14.4 14.6]

[ 0.4 0.2 0. ... 14. 14.2 14.4]

...

[14.4 14.2 14. ... 0. 0.2 0.4]

[14.6 14.4 14.2 ... 0.2 0. 0.2]

[14.8 14.6 14.4 ... 0.4 0.2 0. ]]

**2926.0167229147974**

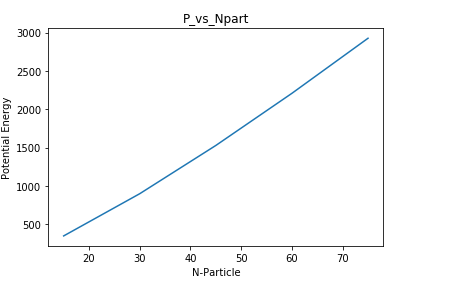


Figure 2. Relationship between potential energy and particle number

3 ) The time required to compute the kinetic energy for five different values of Nparticle:

|  |  |
| --- | --- |
| NParticle | Run Time for Kinetic Energy (sec) |
| 12 | 0.18 |
| 13 | 0.19 |
| 19 | 0.21 |
| 24 | 0.22 |
| 25 | 0.23 |

In [**206**]: runfile('/Users/melissasuchanek/Desktop/untitled17.py', wdir='/Users/melissasuchanek/Desktop')

12

[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Result from loop is 10.120000000000001

Result from numpy sum is 10.120000000000001

Kinetic energy is [0. 0.02 0.08 0.18 0.32 0.5 0.72 0.98 1.28 1.62 2. 2.42]

Total time to run in seconds is: 0.18756389617919922

In [**207**]: runfile('/Users/melissasuchanek/Desktop/untitled17.py', wdir='/Users/melissasuchanek/Desktop')

13

[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Result from loop is 13.000000000000002

Result from numpy sum is 13.000000000000002

Kinetic energy is [0. 0.02 0.08 0.18 0.32 0.5 0.72 0.98 1.28 1.62 2. 2.42 2.88]

Total time to run in seconds is: 0.19441795349121094

In [**213**]: runfile('/Users/melissasuchanek/Desktop/untitled17.py', wdir='/Users/melissasuchanek/Desktop')

19

[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Result from loop is 42.18000000000001

Result from numpy sum is 42.18000000000001

Kinetic energy is [0. 0.02 0.08 0.18 0.32 0.5 0.72 0.98 1.28 1.62 2. 2.42 2.88 3.38

3.92 4.5 5.12 5.78 6.48]

Total time to run in seconds is: 0.21771502494812012

In [**218**]: runfile('/Users/melissasuchanek/Desktop/untitled17.py', wdir='/Users/melissasuchanek/Desktop')

24

[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Result from loop is 86.48

Result from numpy sum is 86.48

Kinetic energy is [ 0. 0.02 0.08 0.18 0.32 0.5 0.72 0.98 1.28 1.62 2. 2.42

2.88 3.38 3.92 4.5 5.12 5.78 6.48 7.22 8. 8.82 9.68 10.58]

Total time to run in seconds is: 0.22081995010375977

In [**219**]: runfile('/Users/melissasuchanek/Desktop/untitled17.py', wdir='/Users/melissasuchanek/Desktop')

25

[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

0.]

Result from loop is 98.0

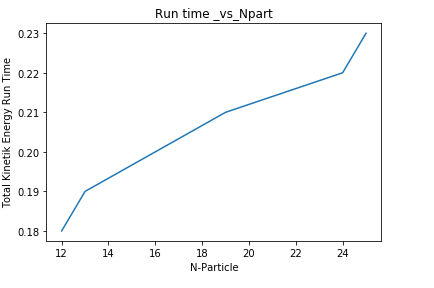
Result from numpy sum is 98.0

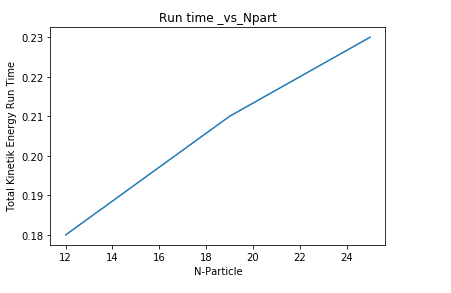
Kinetic energy is [ 0. 0.02 0.08 0.18 0.32 0.5 0.72 0.98 1.28 1.62 2. 2.42

2.88 3.38 3.92 4.5 5.12 5.78 6.48 7.22 8. 8.82 9.68 10.58

11.52]

Total time to run in seconds is: 0.2361609935760498





In this graph particle N13 and particle N24 are not included. Indeed, the total kinetic energy run time versus particle numbers observed linearly.

The time required to compute the potential energy versus particle numbers expected to scale quadratically. My work is still being on the process.